

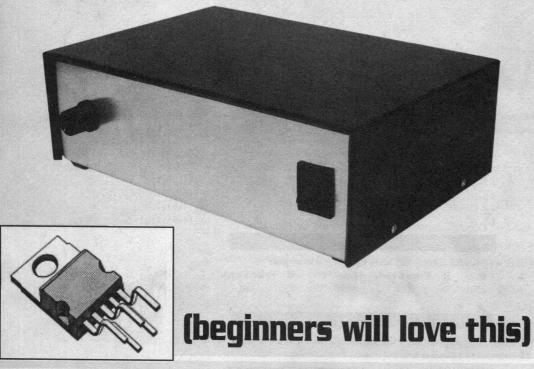
BOOK REVIEWS:

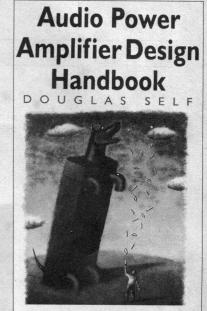
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DESIGN HANDBOOK
by Douglas Self

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KT66	68	KT88	86	8550C	22	807	8	311	18	312	28
813	28	815	22	808	30	12E1	14	1LE12	36	1SE1	90
8L8G	12	7581A	15	7504	38	DA41	14	DA12	14	DA100	675
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0.02 μf	600	£1.49	0.002 μf	1000	£0.64	120 pf	500	£1.78	50+50 μf	400	£10.62
0.05 μf	600	£1.68	0.006 μf	1000	£0.77	220 pf	500	£1.88	220 µf	400	£18.40
0.1 μf	600	£2.17	1.0 µf	600	£2.18	470 pf	500	£2.10	470 µf	400	£20.18
0.22 μf	600	£3.12	20.0 µf	600	£5.43	680 pf	500	£2.18	1000 µf	400	£32.06
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845	11K		4-8-16	80	30	SE	114x95x135	144
KT66	4K5		4-8-16	68	5.8	SE	114x95x100	95
KT88	5K	40%	4-8-16	90	50	P/P	114x95x110	108

All chassis are made from solid copper 2m/m thick with welded corners and 5m/m flange for bottom plate

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D.I.Y. Supplement

Contents

KIT NEWS

From transformers to tweeters, you'll find some rare but valuable hi-fi bits in this section.

30 watt SILICON CHIP AMPLIFIER

This has got to be the greatest way to build your first amplifier. Dead simple but very effective. Great for beginners, the impoverished, students and audio addicts everywhere.

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Whatsa Black Gate? You mean to tell us you don't know? It's somfing black sheep go through. If you believe this, then you need to read this feature to protect your audio cred. Or jump off a cliff in shame.

BOOK REVIEW:

ACOUSTICS AND PSYCHOACOUSTICS

by Howard and Angus

A goodly sized tome covering sound, room acoustics, human hearing mechanisms and perceptual strategies, plus electronic sound processing. Reviewed by Noel Keywood.

AUDIO POWER AMPLIFIER DESIGN **HANDBOOK**

By controversial but experienced designer Douglas Self, this book is backed by solid practical experience, available research and Self's interest in producing the 'perfect' amplifier. Reviewed by another designer of great experience and knowledge, Andy Grove.

DIY QUERIES

Loads-a-Queries from our DIY swagbag. This is where the discussions are technical, esoteric - and interesting! Yes, lots of in-depth info on what makes a good hi-fi design.

of

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resource guide, (\$10.00 U.S. including surface mail anywhere) call, write or fax us. We will send you the catalog, a copy of our latest Breadboard with our specials and N.O.S. tube listing, and a coupon good for \$10.00 off your first order of \$100.00, or \$25.00 off your first order of \$250.00 or more.





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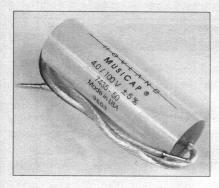
VOLUME ?

KIT NEWS

MISSING LINK

The latest audiophile catalogue from Audio-Links of Scunthorpe is now available. Priced at £2, it contains high quality resistors (running from Vishay bulk foils through to Holco's 0.5% H8 series), capacitors (Ansar Supersound and Silversound, Hovland Musicaps, Elna Cerafines and Panasonic Os-cons) and potentiometers (Alps Blue and Black Beauty as well as Panasonic).

There's also a range of switches, connectors (including gold-plated cartridge tags) and interconnects in addition to loudspeaker and mains cables. The bullion brigade get a look in with pure silver wire, from 36gauge to 14gauge, and matching silver-loaded solder.

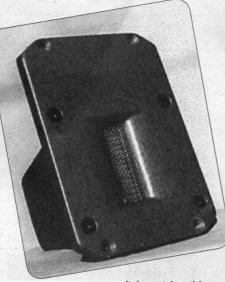


Transistor fans will be happy to find Schottky and soft-recovery diodes, voltage regulators and low noise toroidal transformers as well.

Audio-Links
7 Fairmont Cresc.,
Scunthorpe,
North Lincs.
DN16 IEL
Tel: 01724 870432

RIBBON SINGS THE HIGHS

If dome tweeters fail to bring a smile to your face and ribbon tweeters are more your cup of tea, there's now one more to choose from with the arrival of the HRL-Is from Howard Dawson Audio. These are built around powerful ALCOMAX-3 magnets and an extremely



lightweight ribbon to maximise the driver's efficiency (90dB), speed and accuracy.

Given the fact that a pair of HRL-Is will set you back £300, replacing the ribbon element itself is reassuringly cheap (£10) and easy - owners can even make new ribbons themselves, according to Howard Dawson. And almost any impedance can be specified because the HRL-I's matching transformers are interchangeable.

Howard Dawson Audio 16 Copeman Road, Aylsham, Norwich NRII 6JL

ITALIAN TRANSFORMATION

If you're having a hard time making up your mind as to what output transformer to buy for that killer valve amp you've been slaving over, Bartolucci can help you out. This Italian company offers over 60 different output transformers to suit a range of valves. Power handling is between 10W and 50W for transformers aimed at single-ended amps, while push-pull versions run from 8W up to a healthy 140W.

All the above transformers are multiple section, multiple layer designs, hand-wound for accurate interleaving and correct wire tension. They come potted with micro-crystalline wax in a hand-made steel enclosure, with output taps that allow matching to 'speakers of

4, 8 and 16 ohms impedance.

Further broadening Bartolucci's brochure is a step-up transformer for MC cartridges as well as interstage coupling and pre-amp output transformers.

Helping out in the power supply department is a range of chokes, running from 10H at 400mA up to 150H at 50mA.

Audio Marketing Via del Meridiano 38, Domagnano, 4703 I San Marino Tel: (378) 906634

WHAT, MORE TRANSFORMERS?

SJS Electroacoustics are expanding their transformer goodie bag and now offer five interstage transformers (with prices from £149 to £189/pr) to complement their pre and power output transformers. Fans of single-ended will

be happy to see

offered not only
the Standard and Super range (with its
superior windings) but also five 'state of
the art' transformers. These all employ
very complex winding techniques and
high purity Oxygen Free Copper with
PTFE-insulated, pure silver flying leads,
and are potted in non-magnetic cases.

Occupying the catalogue's other pages are power supply chokes and capacitors (custom polypropylenes, Black Gates, Mallorys, Spragues and Hovland Musicaps), Holco H2 IW I% resistors and silver cable.

SJS Electroacoustics Ben-Dor, Lumb Carr Road, Holcombe, Lancs. BL8 4NN Tel: 01706 823025



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chosen the best manufacturer for each type, with an emphasis on the highest audio quality and product reliability. We stock one million valves including: BRIMAR, GE USA, GEC UK, MAZDA, MULLARD, RCA, RUSSIAN/SOVTEK/SVETLANA, SYLVANIA, TESLA, THERMIONIC, TUNGSRAM and other rare brands, as well as sockets and CRTs.

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12BH7A GE	15.00	ECC86 Tungsram	3.45	
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MATCHED TESTING 22.00 per valve (24.00 p	el pail)

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Want to build your first amplifier? The simplest way is to use a dedicated silicon chip. The components shouldn't amount to more than £60 and there are no naughty voltages. Chris Found explains, step-by-step.

V set manufacturers are just one example of those who use onepiece amplifiers on a silicon chip. There are plenty to choose from. These amplifier modules are not in the High End league but they certainly fulfill basic requirements well, giving lots of Watts per Pound.

For a student with very little money or someone who is just starting a course in electronics and needs to gather firsthand knowledge of building, these units are an ideal starting point. To build the units presented in these articles you need to be able to solder components to a board and want to do something you might never have done before.

When I looked at the data sheets, today's sophisticated chip amps look like an amazing bargain. We chose one that is easy to obtain, has been honed through useage and is, technically, easy to understand as well. It is the

SGS Thomson TDA2050. A stereo amp. needs two of them, amounting to no more than £12. However, the mains transformer can cost up to £15, electrolytic capacitors £8 or so and a chassis / heatsink any price you choose. So it's impossible to put an exact price on this amp, but £60 should do it easily.

The SGS-THOMSON

words a T0220 transistor with five legs instead of three. Bear the package type in mind when selecting a heatsink.

It is capable of working on single or simple split rail power supplies. The split rail supply option is especially useful because it eliminates the output coupling capacitor, and its degradation of sound quality.

The 2050 can produce

rail of +/- 22V.

You might feel that 10% distortion is just a tad excessive, but it is merely a way of defining overload and maximum output. For most music applications such as an audio stage in a TV set, the distortion will be substantially lower than this, as our measured performance figures show. Performance is very good indeed for its low price and this chip is both robust and reliable - almost bombproof in fact.

Sophisticated circuit protection has been applied, as well as thermal limiting. This makes the TDA2050 an extremely reliable product for any manufacturer, but also for the DIYer.

Looking at the 2050's operational schematic diagram (Fig 1, p8) shows just how simple the unit is to construct. Just eight components per channel are needed, plus decoupling and power supply components. Providing you are careful



TDA2050

32W Hi-Fi AUDIO POWER AMPLIFIER

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- THERMAL SHUTDOWN

The TDA 2050 is a monolithic integrated circuit in Pentawatt package, intended for use as an audio class AB audio amplifier. Thanks to its high power capability the TDA2050 is able to provide up to 35W true rms power into 4 ohm load and up to 32W into an 80hm load.



TDA2050

The TDA2050 is an Integrated Power I.C. built into what is normally called a Pentawatt package, in other

some 35watts into a 4Ω load (the limit being defined by 10% distortion) when using a supply of +/-18volts, or 32 watts into 8Ω with a supply

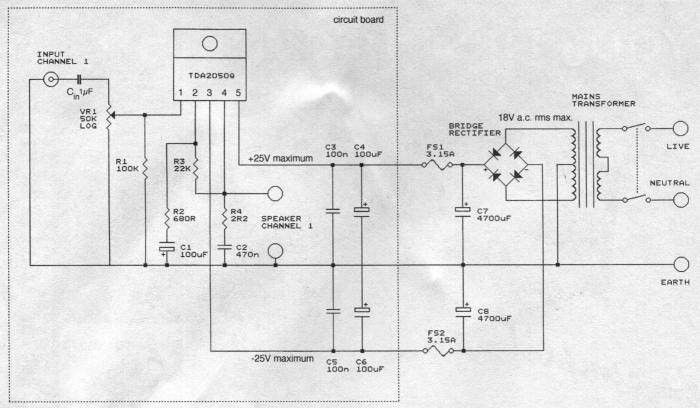


Fig 1 - Schematic of circuit

How the circuit works......

The signal is fed in through Cin, which acts as a d.c. blocking capacitor. This should be left in for safety, since residual d.c. exists on many sources. Remove it if working from a preamp with an output blocking capacitor. Feeding d.c. in will otherwise produce d.c. on the output, which will offset the 'speaker cones.

R1 holds the non-inverting (+) input to ground with respect to d.c. conditions, should the volume control fail to do so. C1/VR1 form a high pass filter with a -3dB point around 4Hz. Lower Cin to $0.47\mu F$ and this rises to around 8Hz, which is where most designers choose to put the lower limit.

Feedback, both a.c. and d.c., is applied from output back to the inverting (-) input through resistor R3, set at 22k. Altering this resistor changes the amount of feedback applied, R3/R2 acting as a potential divider with respect to the a.c. (audio) signal being fed back. Reducing R3 increases the amount of feedback applied. This will increase bandwidth, decrease distortion and reduce gain. Go too far and the circuit will oscillate (i.e. become unstable). Increasing R3 will improve stability and raise gain, but increase distortion and lower bandwidth. Capacitor C2 ensures 100% d.c. feedback is applied. Ideally, this capacitor should comprise two back-to-back tantalums of $50\mu\text{F}-200\mu\text{F}$, in order to produce a non-polarised capacitor.

Components R4 and C2 ensure high frequency stability. Capacitors C3 and C5 ensure power line decoupling is effective at high frequencies. These should be good quality polypropylenes. The chip has both short circuit protection and thermal shut down, so it's rugged.

The chip is designed to accept 25V maximum on its supply rails. We recommend using a mains transformer of 15V a.c. rms, but an 18V a.c. transformer can be used, which will give 23V-24V, taking into account regulation, bridge rectifier losses, etc. A rating of 50VA minimum should be used. Bigger VA ratings give better regulation and stronger bass. Chris Found lists Maplin's DH63T, which has two 15V secondaries, one 240V primary, is rated at 4A and 120VA and costs £18. Cricklewood Electronics (0181-450-0995, 40 Cricklewood Broadway, London NW2 3ET) is where we bought our parts and they can help too. NK

(more so, if you are a first time builder), you should be able to get this unit up and running in no time at all.

I decided to build the prototype amplifier on two separate pieces of 0.1" copper clad Veroboard. It allows the amplifier to be built in easy stages, replacement of one part is made easier, servicing is easier and Veroboard is best when circuits are kept small and simple. Large Veroboard constructions are prone to

problematic mix-ups. Our Veroboard layout is very simple and providing basic procedures are adhered to, the units should work straight away.

FIRST TIME

The following list should be used when constructing anything for the first time. It safeguards not only your hard earned money but also ensures that you do not die in the attempt of building your first unit.

Build each board slowly and follow the drawings very carefully, checking every solder joint, component position and the polarity of the components. If necessary redraw the layout on a separate sheet with all the positions and their polarities.

Where mains voltages are concerned, use sleeved 'crimp on' spade terminals for the mains switch and the IEC mains connector. You can get these from any car spares shop and they are very cheap.

Also use only the appropriate wire suitable for the job in hand. Do not use wire too thin for the mains linking, as this could overheat and cause a fire if left on for an appreciable amount of time.

Triple check everything in accordance to the information given. If you are unsure, ask a local repair shop or a knowledgeable friend to look over the unit. It may cost you a few quid but it's worth it.

Make a final check against

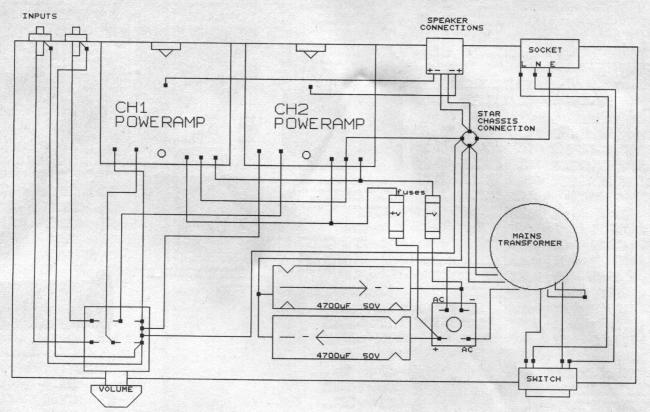


Fig 2 - Amplifier layout

all of the drawings, ensuring the areas that require isolation, i.e. the heat sink and the tab on the devices, are electrically isolated from the chassis but thermally connected using the proper heat sink compound, thereby allowing heat to be dissipated effectively.

When you power up the unit for the first time, do not mind that the large reservoir capacitors used need time to discharge.

Always remember, anything connected to the Mains supply is potentially dangerous.

MAINS VOLTAGES CAN

KILL. Use extreme care and follow all instructions to the letter.

If you have a multimeter check the various test points for their

iron, not the Weller Arc welding type Spanners if you can borrow some

CONSTRUCTION

Cut a small piece of Veroboard 17 strips wide and 17 holes long and clean off the rough edges with a small flat file. Fig. 3 shows the placement of the components

for each of the two pieces of Veroboard. You will notice that these two boards are identical. The remaining power supply components are hardwired. Each piece of Veroboard comes predrilled as standard with copper tracking strips to allow components to be

placed in certain positions. I normally remove all the unwanted tracking to prevent shorts when soldering and put Vero terminal pins in the positions that require wire to be soldered to the boards.

On each of the two amplifier boards the TDA2050 is mounted as close to the far end of the board as possible, track side down. The TDA2050 chip connection pins go through

the opposite side of the board. The metal tab of the 2050 is secured to the inside wall of the case and the optional outside heat sink.

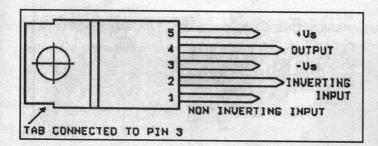
To ensure the board stays rigid and cannot short to the metal case a plastic spacer is mounted at the opposite end to provide support. It helps when wiring up the boards later.

Construction of the power supply section is very simple. I used a large chassismounting bridge rectifier, which is marked on its body +,-, AC, AC.

WIRING THE POWER SUPPLY

First, mount the bridge rectifier to the case using an M3 screw and nut. Next. connect the spade connectors to the secondary wires of the mains transformer then push them onto the AC terminals of the bridge rectifier. They go on either way around; there is no polarity to be observed.

Fix the reservoir glue. Solder the positive wire



connect any speakers to the output terminals. Do not connect an input signal either. Instead very carefully look and smell for burning, but do not get too close just in case there is something wrong. Wear some protection for your eyes if you need to look closer than a few feet. Leave on for only two minutes and then switch off and leave the unit to cool down for at least 15 minutes. Please bear in

correct D.C. voltages on the second test.

TOOLS

The following tools are required to build the amplifier. Small wire cutters Small and medium size pliers Various screwdrivers Files Electric or Hand drill with assorted drill bits 15 or 25W small soldering

capacitors to the chassis, either with a clamp or using of one reservoir capacitor to CRICKLEWOOD ELECTRONICSANSAR SUPERSOUND Audio Polypropylene 400VDC±5%

The secret's in the metallised film



Manufactured specifically for high end audio, these Manufactured specifically for high end audio, these polypropylenc capacitors offer exceptional value for money as they use a specially imported high purity metallised polypropylene film, ensuring smooth, detailed and transparent sound quality and extremely low distortion, whether they are placed directly in the sigmmal path such as in crossovers or for decoupling etc. Ideal for replacing old, stale and leaky capacitors.

Part no	Value	Price
CW100N	CAP PROPYL 100nF	£1.25
CW150N	CAP PROPYL 150nF	£1.25
CW220N	CAP PROPYL 220nF	£1.25
CW330N	CAP PROPYL 330nF	£1.25
CW470N	CAP PROPYL 470nF	£1.25
CW680N	CAP PROPYL 680nF	£1.25
CW1U0N	CAP PROPYL 1µF	£1.25
CW1U5N	CAP PROPYL 1.5µF	£1.50
CW2U2N	CAP PROPYL 2.2µF	£1.50
CW3U3N	CAP PROPYL 3.3µF	£1.85
CW4U7N	CAP PROPYL 4.7µF	£2.00
CW6U8N	CAP PROPYL 6.8µF	£2.50
CW10UN	CAP PROPYL 10µF	£3.50
CW15N	CAP PROPYL 15µF	£4.50
CW22U	CAP PROPYL 22µF	£6.50
CW50U	CAP PROPYL 50µF	£9.95
CW100U	CAP PROPYL 100µF	£20.00

Low value capacitors are axtensively used in amps & Low value capactors are axtensively used in amps & preamps (sepscalin) in tone control, base & treble etc) By changing to polypropylene you can enjoy an enhaanced lighter - brighter sound especially in the treble aand mid bass range, and a transparent lower bass improvement. Close tolerance & high stability ensure that both channels can be very closely matched.

Part No	Value	Voltage	Price
CPP47P	CAP PROPYL 47pF	250V	£0.35
CPP100P	CAP PROPYL 100pF	250V	£0.35
CPP150P	CAP PROPYL 150pF	250V	£0.35
CPP220P	CAP PROPY 220pF	250V	£0.35
CPP330P	CAP PROPYL 330pF	250V	£0.35
CPP470P	CAP PROPYL 470pF	250V	£0.35
CPP1N0	CAP PROPYL 1nF	250V	£0.35
CPP1N5	CAP PROPYL 1.5nF	250V	£0.35

CPP2N2	CAP PROPYL 2.2nF	250V	£0.35	
CPP4N7	CAP PROPYL 4.7nF	63V	£0.50	
CPP10N	CAP PROPYL 10nF	63V	£0.65	
CPP22N	CAP PROPYL 22nF	63V	£0.85	
CPP47N	CAP PROPYL 47nF	63V	£1.00	

Part No.	Value	Voltage	Price
1H50	LO Z HI TEMP 1µF	50V	£0.25
2U2H50	LO Z HI TEMP 2.2µF	50V	£0.25
4U7H63	LO Z HI TEMP 4.7µF	63V	£0.25
10H63	LO Z HI TEMP 10µF	63V	£0.25
22H63	LO Z HI TEMP 22µF	63V	£0.30
47H63	LO Z HI TEMP 47µF	63V	£0.35
100H63	LO Z HI TEMP 100µF	63V	£0.50
220H50	LO Z HI TEMP 220µF	50V	£0.75
470H63	LO Z HI TEMP 470µF	63V	£1.25
1000H35	LO Z HI TEMP 1000µF	35V	£1.50
2200H50	LO Z HI TEMP 2200µF	50V	£2.25
4700H25	LO Z HI TEMP 4700µF	25V	£2.50
4700H25	LO Z HI TEMP 4700µF	25V	£

Choosing the right electrolytic for power supply use is very important in keeping down hum whilst allowing maximum current flow for good transient & bass response. Elna capacitors are respected the World over

Part No	.µF/Voltage	Price
10000C80	CAL ELNA1000µF/80V	£11.00

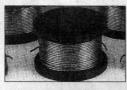
Monacor Air Cored Inductors

A range of professional air cored inductors for 8Ω or 4Ω
crossovers/filters for use up to 300W. 1.2mm enamelled
copper wire wound on air spaced plastic bobbins.

Part No	Specification	Price
P15	150μH 0.15Ω 8x19mm	£2.00

P22	220μH 0.15Ω 48x19mm	£2.50
P33	330μH 0.2Ω 8x19mm	£3.00
P47	470μH 0.25Ω 50x19mm	£3.50
P68	680μH 0.35Ω 59x19mm	£4.50
P100	1mH 0.4Ω 59x19mm	£5.50
P150	1.5mH 0.5Ω 70x30mm	£6.50
P220	2.2mH 0.6Ω 70x30mm	£8.00
P330	3.3mH 0.75Ω 70x30	£10.00

Monocor Ferrite Inductors



rs with very low ohmic losses for 8Ω or 4Ω ers or filters for use up to 400W.

.4mm enamelled copper wire (1.3mm on F1000) wound

Part No.	Specification			Price	
F220	2.2mH 0.15Ω	400W	55x31mm	£6.50	
F330	3.3mH 0.2Ω	330W	65x39mm	£9.50	
F470	4.7mH 0.25Ω	140W	65x30mm	£11.00	
F680	6.8mH 0.35Ω	120W	65x39mm	£12.00	
F1000	10mH 0.45Ω	100W	65x39mm	£13.50	

Affordable range of High Quality Valves

art No.	Description	Price
550C	OUTPUT VALVE	£26.00
L6GT	OUTPUT VALVE	£4.50
SN7GT	OUTPUT VALVE	£4.50
V6GT	OUTPUT VALVE	£3.95
CC81	TRIODE	£4.50
CC82	TRIODE	£4.50
CC83	TRIODE	£4.50
F86	LOW NOISE PENTODE	£3.50
L34	OUTPUT VALVE	£8.50
L84	OUTPUT VALVE	£3.50
Z34	RECTIFIER	£6.50
T88	OUTPUT VALVE	£20.00

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Part No.	Description Price	
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B9AU	B9A VALVE HOLDER CERAMIC + 2.00	
CC	SCREENING CAN £2.25	
OCTC	OCTAL VALVE HOLDER CERAMIC£2.00	
OCTP	OCTAL VALVE HOLDER PHENOL£1.50	

Fully Gold Plated Phono (RCA) Plugs



Part No.	Description	Price
PPG5A2	PAIR GOLD PLUGS for up to	£1.50
	5mm CABLE	pair
PPG8A2	PAIR GOLD PLUGS for up to	£1.50
	8mm CABLE	pair

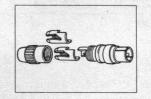
Very High Quality Phono (RCA) Plugs



uality satin grey metal with heavy gold plat i. Top collet cable grip & PTFE insulators. ise.

Part No.	Description	Price
PPG6H2	GOLD PTFE PLUGS for up	£3.50
	to 6mm CABLE	pair
PPG8H2	GOLD PTFE PLUGS for up	£3.50
	to 8mm CABLE	pair

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LPP2QG	1.5 Metres/Green	£6.50
LPP2QV	1.5 Metres/Violet	£6.50
LPP5QG	5 Metres/Green	£11.00
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R70	d=70L=128-245	£3.50
R100	d=110L=160-122	£5.50
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	cabinetsL=210-310	£6.50

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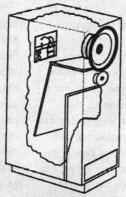
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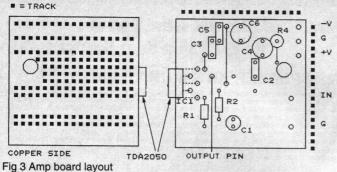
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the + connection of the bridge rectifier. Do the same for the negative wire from the second capacitor, taking it to negative on the bridge rectifier. Solder the free positive and negative

capacitor terminals together and take them to the star earth through another wire.

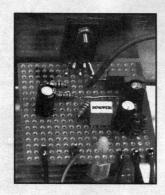
See Fig 2.

The bridge rectifier converts the AC voltage from the mains transformer into a DC voltage that powers the chip. The two reservoir capacitors hold the voltage stable during high signal levels, smooth out hum and ensure that the amplifiers do not effectively run out of steam.

BUILDING THE BOARDS

Mount the smallest components first. These are the resistors which are colour coded in accordance to the value and tolerance of the component. In the parts listing, the colour code

sequence for each resistor is described, so that you can familiarise yourself with this coding. You will notice that R4 is mounted vertically.



Once the resistors are in place, you can now see where the tracks need cutting, with a specialist Veroboard cutter or a 3.5 - 4mm drill. Do not cut into the board too hard or it will break or the hole will be too big. Cut just enough to remove the copper.

Mount and solder the terminal pins to the board

now, to save any damage later. These pins can sometimes be very stiff to put in the holes. Use either the special Veropin tool or a small pair of pliers on the edge of a hard surface, say a piece of wood.

Next mount the capacitors. All have their values and working voltages printed on the side of the part.

Make sure the electrolytic capacitors are fitted the right way round. The bar or dashed line usually corresponds to the negative terminal of the capacitor.

The low value polyester capacitors (the ones without a polarity marking) are non-polar and can be placed any way round without the need to observe the polarity.

Finally fit the TDA2050, making sure not to bend the pre-formed legs too far from their original position as they are quite fragile. They should easily fit into the 0.1" pitch of the Veroboard. Having built the first power amplifier board triple check everything and when you are sure that the board matches the drawing, use it as the reference for the next one.

BUILDING THE CASE

The case is purchased undrilled. Our photograph shows how the prototype

was constructed. Drill the holes to accommodate the volume control and mains switch on the front panel. Drill the holes for the back panel second and, lastly, the holes on the underside of the case.

To form the square hole needed for the push-fit mains switch, measure the switch and mark the square hole with a felt pen. With an electric or hand drill use a 3mm drill bit to start the hole in the centre. Enlarge it with a 10mm drill bit, then with a small round file enlarge this hole until it is as close to the switch outline as possible. Use a small flat file to put in squared corners.

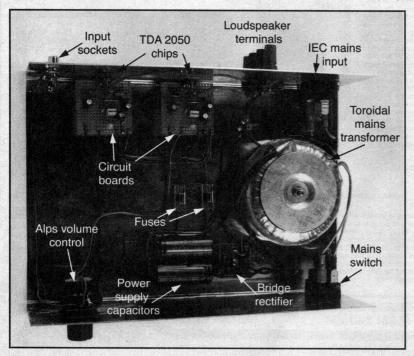
Use the same procedure for the Mains IEC socket on the rear of the case. This socket should be mounted in line with the switch on the rear of the case, so that you use the minimum amount of wire to connect these two parts together. The fixing holes for the socket are normally M3 (Metric 3mm).

Place the mains transformer inside the case on the switch side. Leaving 15-20mm gap from the side of the case mark the centre of the transformer and drill the M4 / M5 hole required for the mounting bolt. Do not fit the mains transformer yet.

Look on the mains transformer body and follow the instructions to connect it to the mains supply.

Fit sleeved spade connectors to the transformer primary leads, carefully cleaning the ends of the wires with a sharp blade just in case they are dirty. Make sure to crimp the connectors properly with a pair of pliers, so as to make the best connection and finish this area by making up the lead that links between the switch and the IEC socket. Check the connections to the switch with Fig 2, to make sure that these connections do not short the mains when the switch is activated. Fig 2 shows the normal connections for a standard double pole rocker type switch.

Finally connect the earth wire and secure one end to the case, using a solder tag and an M3 screw and nut to firmly fit it to the case. You can now fit the mains transformer to the case, using the supplied hardware. Lightly tighten the fixing bolt, but not too tight.



П

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proud to own.

Why not buy the reprints and construction manual for the kit you are interested in to see how easy it is to build your own equipment the HART way. The FULL cost can be credited against your subsequent kit purchase.

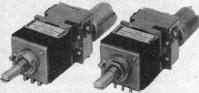
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This fantastic John Linsley Hood designed amplifier is the flagship of our range, and the ideal powerhouse for your ultimate hi fi system. This kit is your way to get £K performance at bargain basement prices. Unique design features such as fully FET stabilised power supplies give this amplifier World Class performance with startling clarity and transparcncy of sound, allied to the famous HART quality components and ease of construction. Standard model comes with a versatile passive front-end giving switched inputs, with ALPS precision "Blue Velvet" low-noise volume and balance controls, no need for an external preampl. Construction is very simple and enjoyable with all the difficult work done for you, even the wiring is pre-terminated, ready for instant usel. All versions are available with Standard components or specially selected Super Audiophile components and Gold Plated speaker terminals and all are also available factory assembled. K1100 Complete STANDARD Stereo Amplifier Kit, £415.21

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sue of EVW the new version retains the basic simplicity and purity of the original but with modern components and an increased power rating of 15W RMS per channel. Full Kit in 3u high Rackmount Case. £388.25 Set of 3 PCBs only. £60.50



This attractive module consists of a low pass filter and power amplifier ready for you to mount in a suitable sub-woofer cabinet. The combined unit can then be combined with any new or existing hi if to home cinema speaker system to add in the real bass punch missing from most setups.

The ASM 100 module comes as a ready-to-mount unit on a solid

The ASM 100 module comes as a ready-to-mount unit on a solid diecast aluminium frame/heatsink. Input signal can be at line or speaker level for easy system integration. There are three separate stereo inputs at line level and the unit will use any signal presented or mix all inputs to add bass to any signal. The speaker level inputs are used by simply wiring the unit in parallel with the existing speakers to provide them with strong bass support. Crossover frequency can be selected to 50, 100 or 200Hz and the bass level can be adjusted by a front panel control. The 'Green' power supply switches the unit to standby if no signal is present. Drawings are included free for the compact 418 x 380 x 303mm cabinet. With its powerful 125 watt output and versatile filtering the ASM 100 is the ideal universal active driver module for all subwoofer requirements.

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An Ultra High Efficiency speaker, specially suitable for Valve

Amplifiers.
Specially selected as the ideal partner for the new John Linsley Hood 15W Valve Sound Amplifier, or indeed any actual valve amplifier, the FIESTA 30 features the astonishing efficiency and sensitivity needed to achieve a satisfying sound level from amplifiers of limited power

output.
To complement the sound purity of such amplifiers a full three speaker system is used with a 300mm (12") woofer, 200mm (8") mid-range and

200mm (8") mid-range and high quality horn tweeter in a vented bass reflex enclosure. All these drive units have been carefully selected for their individual virtues, and collective excellence, the tweeter for instance being a high end unit with exceptional pulse response as a result of its combination of Kapton former, aluminium diaphragm former, aluminium diaphragm and aluminium voice coil.

Nominal Power Rating is 150W, Max. Music Power 250W, Impedance 8 ohm, Mean Sound Pressure 91dB. Speaker kit comes with all parts to make a pair of speakers, but not the cabinet parts. Crossover units are factory assembled, ready to fit.

Kit No.LK5963 Per Pair. £424.93

HOME CINEMA SPEAKERS.

The VISATON range of speaker kits includes all you will ever need Ine VISATOR raige of speaker his initiouse all you will ever level for your surround sound home cinema setup. The Hi-Tower Kit is ideal as a super luxury pair of stereo main speakers. The "Centre 80" uses special magnetically screened drivers to avoid picture disturbance and a pair of "Effect 80"s are used as rear speakers. Any of a range of sub-woofers then adds weight to the sound of the robot feet!. Centre 80 Kits include drive units, crossover, terminal and grille. (You make the box) Price each. . . Effect 80, Rear Speaker Kits, per pair,

DRIVE UNITS.



BG30NG 30cm. (12") Woofer. High efficiency, (95db) for sealed or vented cabinets. Peak power £69.61 ndling 250watts. 8 ohm.

W200S 20cm. (8") Woofer. Long throw unit with rubber surround and throw unit with rubber surround and extended rear pole to give no less than 20mm cone displacement. Ideal for compact sub-woofers such as ASM-W20. 8ohm. £36.68 NG8 Protective Metal Grille. £5.66



Coated paper cone, rubber surround, high temperature voice coil. Suitable as woofer in mini enclosures or midrange in 3-way systems. 4ohm.

NG4 Protective Metal Grille. £3.20

FRS8 8cm.(3.3") Fullrange driver. Linear frequency response between 200 and 20KHz. Large Magnet, 20mm voice coil and rubber surround. 8ohm. £8.36



DT2.5 10mm Polycarbonate Tweeter

High efficiency ferrofluid tweeter for use over 4,500Hz. Very good price/performance ratio. 80hm. £8.77





RHT12S High End Ribbon Tweeter. Superior double magnet construction gives an exceptionally low distortion and linear response from 4,000 to 30,000Hz. Cabinet cutout diameter 95mm. 8ohm. £87.77

DHT9AW-NG Hi-Tech, Hi-Fi, horn type tweeter. Frequency response from 3,500 to 38,000Hz and very good pulse response due to aluminium cone, Kapton voice coil and aluminium wire. Peak power handling 150W. 8ohm. £31.99



ASM100 and our 80 watt power amplifier are on demonstrati Wilmslow Audio's new premises at Broughton Astley Leicester. Tel 01455 286603.

POSTAGE on UK orders is £2 up to £20, £4.50 over £20.

Overseas please enquire.

Our LISTS are FREE on request.

Send for Your FREE copy of our LISTS

24 Hr. ORDERLINE 01691 652894 Fax. 01691 662864

All Prices include UK/EC VAT.

Connect the linking wires from the power supply to each of the two power amp boards. Now fit the volume control and solder the two dual-screened wires to this

case, making sure that the isolating bushes supplied fully isolate the sockets from the case and the sockets are secured tightly.

Wire up the speaker

HEATSINKING

Use as much heatsinking as possible to keep the chips cool. SGS Thomson recommend 60mm of a 4.2C/W rated profile, per chip. If the amplifier is not to be driven hard, then a thick plate of aluminium (12gauge) will conduct heat away adequately. If it isn't big enough the chip will simply shut down temporarily.

Maplin stock a range of heatsinks for TO220 packages that will allow higher dissipation, like their KL-100-1, price £3.99.

and to the audio input sockets. The floating wires from the volume control connect to the amplifier boards.

Fit the speaker connectors to the rear of the terminals with two short runs of either 49 or 72 strand speaker cable. The rib on the cable normally connects to the negative terminal, the other end of the ribbed wire going to the

4 Band Colours

marked on body of component

marked on body of component

Oty I

power supply board earth (Fig 2). The positive lead connects to the amplifier board output pin.

Now is the time to mount each of the two amplifier boards in turn. An isolating mica washer goes between the 2050 tab and the metal of the case; it conducts heat but not electricity. Apply heat sink compound to the device and to the mica. Fit the stand-off spacer to the case and carefully mate the board to the back panel. Push an M3 screw through from the outside. Fit the screw isolating bush (used with metal screws) and lightly tighten the securing nut. Once the board is secured on the back, gently push the board onto the

stand-off. Finally, solder on all linking wires.

If you plan to use the optional heatsink, put some heat sink compound on the back and mount this to the rear of the case.

Once everything is fitted into the case, check all of the connections. Power up the unit and follow the instructions described earlier. Make final checks, connect everything up, put the 3.15A fuses into the internal fuse holders, switch on and try some music .

PARTS LISTING

Resistors

AMPLIFIER BOARD PARTS

RI	$100 \text{K}\Omega$ 1/4W Metal film	Black Brown Yellow	Black Brown Orange Brown	Qty 2
R2	680Ω I/4W Metal film	Blue Grey Brown	Blue Grey Black Black	Qty 2
R3	22KΩ I/4W Metal film	Red Red Orange	Red Red Red Brown	Qty 2
R4	2Ω2 I/4W Metal film	Red Red Gold		Qty 2
VRI	50K $Ω$ Stereo Log Potentio	ometer		Qty I
ICI	TDA2050			Qty 2
CA	APACITORS			
CI	100μF Electrolytic 25V		marked on body of component	Qty 2
C2	0.47µF Polyester 63V		marked on body of component	Qty 2
C3	0.1 µF Polyester 63V		marked on body of component	Qty 2
C4	100µF Electrolytic 25V		marked on body of component	Qty 2
C5	0.1 µF Polyester 63V		marked on body of component	Qty 2
C6	100μF Electrolytic 25V		marked on body of component	Qty 2
PC	WER SUPPLY P	ARTS		
Brid	ge Rectifier	KBP02506	marked on body of component	Qty I

Electrolytic 50V

Electrolytic 50V

3 Band Colours

C7 4700µF

C8 4700µF

Соптобы	marked on body or component	it Qty i
MISC. COMPON	IENTS	
MainsTransformer	Maplins DH63T	Qty I
Case		Qty I
Mains IEC socket with inte	nal fuse holder	· Qty I
500mA 20mm Anti-surge for	ise in a second of the second	Qty I
3.15A 20mm Anti-surge fus	es	Qty 2
Chassis mounted fuse hold	ers	Qty 2
DPDT Rocker mains switch		Qty I
Red 4mm Banana sockets		Qty 2
Black 4mm Banana sockets		Qty 2
Sleeved spade connectors		Qty 7
Assorted colours of wire, in	ncluding 12" of 3A mains cable	
Veroboard		Qty I
Veropins		Qty I pack
Plastic stand-off spacers		Qty 2
Assorted length M3 screws	, nuts and washers	

Most of the components were sourced from Cricklewood Electronics London, with the exception of the potentiometer which is from an ALPS dealer and the transformer from Maplins.

MEASURED PERFORMANCE

Frequency response was very wide at 5Hz-150kHz. The upper limit is arguably too high; we noticed slew rate limiting occurring. However, CD cannot deliver signals above 21kHz, so this should not be a problem in practice. There is plenty of leeway here for feedback reduction.

Power output depends upon supply volts. What you have to bear in mind is that the tiny Pentawatt package must have heat drained from it fast if it is to deliver full power without running into thermal shut down. This means mounting the 2050 tabs direct onto very thick aluminium (e.g. heat sink) or copper (acting as a heat conductor to a sink).

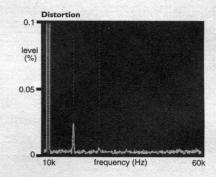
Distortion was low even at high frequencies, an impressive result. This really is a well worked out amplifier design. Distortion figures were low enough for some feedback reduction to be tolerable.

At 500mV for full output, sensitivity was high enough to suit most, if not all sources. Some budget cassette decks and tuners deliver just 300mV. Otherwise, most sources nowadays deliver 500mV-IV, CD delivering 2V of course. So this amp, as it stands, will match most sources. Sensitivity can be increased by reducing feedback.

There were no switch-on thumps and D.C. output offset measured a very low 1.7mV / 2.4mV, much like that of quality commercial amplifiers.

The TDA2050 offers a level of measured performance similar or better than everyday commercial designs. It's great for DIYers. NK

Power (8Ω)		32watts
Frequency response		5Hz-150kHz
Separation		85dB
Noise (CCIR)		-101dB
Sensitivity		500mV
dc offset		1.7 / 2.4mV
Distortion (8Ω)	IW	full o/p
lk	0.02%	0.04%
10k	0.01%	0.13%



All Audio Note triodes are available in Cobalt blue, Ruby Red, silver or gold glass on request at an additional US\$ 125.00 per valve, delivery normally about 90 days as a special order.

kudio Note AV-type triodes will carry a real 2,000 hours or one year warranty, whichever comes first will be applying this warranty without discussion or delay. Specification sheets against stamped self reased envelope with \$ 3,00 or US\$ 5,00 for copying. Available from all participating Audio Note

ricipation is the name of the game and Audio Note is happy to provide a wide range of complete is put and mains transformers, closius, paper in oil, aluminium. In: coppor or share foil signal selection. Back State, Cardian or situational description capacition, statement and metal film selection. Back State, Cardian or statement of the selection of the selection of the selection of the selection of the production. Selection of the production. Selection of the production of the selection o

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Attempts to make 55 technology conform to current technological measurement dopma here softs ability fluxes in on small part to many of you been and persistent poopls out them, who have for many conformation of the property of the prope

is find and will remain the last word in sonic quality if you approxish music properly respondence, there interesting support of the SC-revolution is a historing to incorporate lesses of current checklogical drops and beliefs into the SC performance envelope, we are although earlier join district checklogical drops and beliefs into the SC performance envelope, we are although earlier join district of support price and price of the school of the school of prover specifications are no post of support price and price and price of the school of prover specifications are no post of the size of the school of the school of the school of prover specifications are no post of the SC test in SC at 211 has about 50% amonds distortion, one has to question the school guilty of any part after distortion than 11 cmf pin engaginary per are much them and largely on exposing the strations where environifiable claims are present on an enterspecting public, as they do trying to public the benefits of CC and wherever other own convents between 50% and prepared the school public the benefits of CC and wherever other own convents between 50% and prepared the school public normal processing and the school public the school public and the school public of the school public o

would not be a marketing dischardings.

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offering the speaker drivers that we use in our own loodspeakers for general sale from nor by the drivers individually or logither with a package that shows the crossover must calculat diversing, logither with a pair of ports. We have speak for more time looking particulations are proposed to the proposed of the properties of the properties that one scheduled have accordanced by the properties of the properties of the properties that our scheduled have accordanced by the properties of the prop

We offer our drive units with both copper and silver speechcolis, the measured difference is negligible, but the difference in sound between the two is very great indeed, which again begs the question what it is we measure in relation to what we buse

0	der Code	Driver Type	Crossover RangeCone Material	Price Ex. UK Vat
SI	PKR-031	1 Inch dome tweeter copper coil	2 - 3 KHz/mpregnated cloth	31.75
	PKR-032	1 Inch dome tweeter silver coil	2 - 3 KHz/mpregnated cloth	51.35
	PKR-002	8 Inch woofer, copper coil	up to 3 KHz/Paper, coated centre	47.75
	PKR-003	8 Inch woofer, silver coil	up to 3 KHz/Paper, coated centre	96.75

We also use only a minimal amount of wadding, and it has to be a specific type, preferably well cleanes sheeps wool, positioning is critical, and here experimentation is recommended, if you build the speake yourself

s will sell you a basic kit of crossover parts, a cabinet drawing and a port tube, and then you can periment with the cabinet itself to your hearts delight, alternatively we offer a complete tested kit of vers and crossover, a cabinet drawing and the port tube, which, fi you follow the directions carefully the party and a fulfil bles carefully.

Order Code	Description	Price Ex. UK Vat
SPKR-KIT-OI	Kit of crossover parts, drawings, descriptions and port tube	100.00
SPKR-KIT-02	Tested and calibrated crossover with matched COPPER COIL driven drawings, description, port tube	375.00

The price is for two speakers, if anyone wants mono only then halve the price, the speakers in que

are similar to the AN-E/D which are close to 94 dB efficient in a cabinet 90x36x28centimeters, and are designed to stand crose to rear and side walls.

We will not be offering silver versions of these kits, as the time it takes to test, match and calibrate the crossover to the drivers is so great and the final testing in done in situ in the cabinet, all of which makes it impossible to offer a comparable quality to the AN-E/SE Silver speakers we sell finished, so do not

Apart from the kits all the prices in this list are excluding UK Vat at 17.50%, which, if you live inside the EEC, UK Vat will be added to your purchase, after the addition of postage and packing costs. If you live outside the EEC the price you see is the price you see in the price you say.

Delivery is normally about 14 days from receipt of cleared funds, but please allow up to 60 days for some items, if not stock at the time or order.

If any of you reading this have possession of any books which contain information relevant to the subject of Audio Design and which would be useful to share with others, please let us know either by fax or bisphone, there is an exert of C20.00 (payable in valves or other bits, postfree) to anybody who sends us a book which contains useful information about valve amplifier design or theory.

Likewise, I am looking for a number of old valves to experiment with, so if you have any PXFs PXZS's, DXR's, ARI's, carry of the old violent, will be happy to buy or raising at a good price, likewise suprior of you know where the first of classification process. SURGER, TELESPARCE, AMPRESS or the law, encord cutting, platters, processing or pressing experiment, or have books or information bent building intercolones, recording involved, Informatication, the mit will all gentles presents. AUDIO BITES has the related on very the need 2 - 2 years to set up recording and record manufacture and whilst we derived live quality and of information, count increase in stooled.

Since mothing really attack which place a reasonable background to the subject of valve amplifier circuit which place are reasonable background to the subject of valve amplifier circuit which place more lackground to the subject, do not expect to become an installar supert, and it was serve as under inference. On the background to the subject, do not expect to become an installar supert, and it was a reasonable to the background to the subject as well not be reasonable to the properties and in the properties are self-inference to the properties and in the subject as a subject and inference to the properties are self-inference to the subject as a subject and inference to the properties are subject to the subject and inference to the subject as a subject and subject and include the subject as a subject and subject and subject as a subject and subject and subject as a subject and subject as subject as a subject and subject as subject as a subject as subject as subject as subject as subject as subject as a subject as subje

Nove 1 bet you have never heard of this one below, but demanstrating the streepth of the revival in everything that has to do with values, whether stayle-ended, push-pail or just old and good. Vacuum Tale Wally in a quarterly, this quality port and refail, each last because on 100 found of yeartur-year. The below about the SAL year to the stayle of the stayle of the stayle of the stayle of yeartur-year. The below about the SAL year to street year to the year year to year year when excellent and an interesting overview of available set of vitrage types. The Audio Tast Borch books at both and explorent too for amplication building, we present in our sent Carbon Land set to those and explorent too for amplication building, we present in our sent Carbon Land Land has the VOSC and the best good belief in genera. These matching value matching to us things assemble him out at 15 All 2 may or freely from VVV 1006, E. Duarre Are. Salle 106, Swenyvier CA 49400, 1004, \$3.500 for foreign subscribers.

THE AUDIO ADVENTURE.

Another good alternative to the established magazines, still developing and not atraid to take a controversiol stance, has two of my favourite writers on their stall, Mylex Astor cod Dayna B the Hill Hussy, so get a copy and see for yoursell.

If you are in doubt asto whether a kill project is suitable for you, we suggest you spend £ 10.00 and buying the instructions for the KIT ONE; single 10008 amplifier, this will give you a good idea whether a kill project is for you. A good exist buy buy in the mit of 1000 bill be included against the cost of the KIX part of the form of the cost of the cost of the cost of the kIX part of the form of the cost of the kIX part of the form of the form of the kIX part of the KIX

We are in the process of building up four separate ranges of Audio Note output transformers, morder to offer the best possible outputs at different pricepoints, they will fall into four categories.

A.) Economy range, where the price/quality relationship is carefully calculated to ensure audio quality is a compact package, initially we will concly be offering 3 single-ended output transformers in this range, push-pull outputs are under development as well.

C.) High Quality range, this will be a range of double C-core outputs for single-ended circuits exclusively, no push-pull outputs will be offered, unless demand requires it. Again 3 offerings initially

The quality orderis for group A are 20% to 20% t - 1 to -1.568, they are IE coved with silicon steel laminations and are supplied with frames and solder tags, which will allow good audio quality at the cost. The main cost saving being the save of a smaller cost, specified to the east power level required to the same, cost saving being the save of a smaller power to the same to the same.

Group B are typically 20Hz to 40KHz minus 1.5dB, IE cored with high quality silicon steel laminations wound with oxygen-free copper wir,e and supplied with either bell-ends or frames always with flying

Group C are typically 1 6Hz to 50KHz minus 1 .5dB, strigwound double C-cores made from the cess available silicon steel lamination, these outputs will compare more than favourably with the best available types from days gone by and from other current sources like Partridge, Tango, Tamura etc.

Specifications, PP = Parallel Push-Pull. SE = Single-ended. PSE = Single-ended Parallel. UL signifies 43% uttralinent taps, as a general rule we do not condone the use of UL-taps, as we consider these detriment to sound quality. * * Dynaco replacement.

All our output transformers are tested to insulation levels of minimum 3,000 volts, all 211/845 outputs are insulated to SKv flash, every transformer is tested to this level of insulation.

In addition to the output transformers offered below, we offer a design cervice, where we can supply arross by requirement for widelesed transformers, whether for incorpiouse, moving ool carridges, here to be a supply of the company of the comp

AUDIO NOTE AUDIO QUALITY OUTPUT TRANSFORMERS

Current	THUE EX.					
		Pow			U	K Vat
TRANS-144		300	B/2A3/6B4G	15 w 2K5	4/8 Ohms	
80x67x68m	m	90m	A SE 44.50			
DAYS ON	801A/VT62/845	20 v	v 6K - 4/8 Ohm		00mA SE 7	3.50
	010000000000000000000000000000000000000		TALES IN SE			
Group B.						
Order Code	Recommended	Max	Primary-	Size	Maximum	Price Ex.
	Valves	CI. A	Secondary		Current	UK Vat
		Power	Impedances			
	EL84/ECL86/6V6		2K6 - 4/80hms	117x98x90mm	110mA PSE	87.00
TRANS-152	300B/2A3/6B4G	25 w	2K5 - 4/8 Ohms	117x98x90mm	90mA SE	91.00
TRANS-130	EL34/6CA7	30w	IK5 - 4/80hms	115x98x95mm	180mA PSE	113.00
TRANS-115	2A3/6B4G	30w	IK25-4/80hms	98x82x95mm	130mA PSE	113.00
TRANS-135	5881/KT66	30w	2KI - 4/80hms	115x98x95mm	140mA PSF	106.00
TRANS-205	211/VT4C/845	50w	10K - 4/80hms	112x134x150mm	150mA SE	124.00
TRANS-120	3008	50w	1K25 -4/80hms	135x115x125mm	180mA PSE	151.00
TRANS-140	845	50w	2K5 - 4/80hms	137x114x130mm	180mA PSF	172.00
TRANS-180		75 w	5K - 4/8 Ohms	137x1 15x145 mm	240mA PSE	237.00
TRANS-153	EL34/6550/KT88		3K - 4/80hms	117x98x92mm	130mA SE	104.00

TRANS-180 211NT4C	75 W	5K - 4/8 Ohms	137x1 15x145 mm	240mA PSE	237.00	
TRANS-153 EL34/6550/KT88	20w	3K - 4/80hms	117x98x92mm	130mA SE	104.00	
TRANS-189 300B/2A3/6B4G	25w	2K5-4/8/160hms	117x98x90mm	90mA SE	102 50	
TRANS-155 61 66	30w	3K -4/80hms	115x98x95mm	140mA SE	107.00	
NEW SE Product	200			110110100		
TRANS-138 6550/KT88	80 w	2K3-4/8 Ohms		110mA PSE	199.00	
11040-100 0000H100	00 11	END TO OHING		TIOMATOL	123 00	
Group B						
Push-Pull Circuits						
				No. 1 18 19 19 19 19 19 19 19 19 19 19 19 19 19	12000	
TRANS-200 EL84/ECL86/6VE		8K-4/8 Ohms	80x67x68 mm	PP	42.00	
TRANS-185 EL34/6L6G/5881	25 w	6K-4/8 Ohms	88x73x80 mm	PP	59.00	
TRANS-175 2A3/6B4G/300B	30 w	5K-4/8 Ohms	88x75x80 mm	PP	63.00	
TRANS-190 KT88/6550	50 w	6K6 -4/8 Ohms	108x91x90 mm	PP	73.00	
TRANS-160 FL34/KT66/5881	50 w	3K -4/8 Ohms	98x82x83 mm	PPP	74.00	
TRANS-195 845	50 w	6K8 -4/8 Ohms	108x91x90 mm	pp	114.00	
		4K3-4/8/160hme				
TRANS-170 KT88/6550	60w		125xiO0xil3mm	UL PP	*111.00	
TRANS-137 KT88/6550	100w	2K2-4/8/160hms	150xl47xll8mm	UL PP/PPP	*134.60	

Group C. Single-ende	d only					
	300B/2A3/684G	25 w	2k5 - 4/8/160hms		90 mA SE	360.00
TRANS-310	211/VT4-C/845	50w	IOK-4/8/160hms	165xl48xl40mm	150mA SE	410.00
TRANS-305	300B	50 w	1 K25-4/8/1 60hms	1 65xl 1 Oxl 38 mr	n180 mA PSE	396.00

Brase D.

Fine Silver Wired

Bulguda

TRANS-4002008/PAJ (6940 25 w 265-46 Dinns 117-686/00 mm 90mA SE 1,845.00

TRANS-410211/VT+C/945 50w 10K-490hms 112-68/41 50mm150mA SE 1,975.00

The AUDIO NOTE silver wired outputs listed here are designed and made in the UK, we can supply the AUDIO NOTE Japan manufactured outputs for the ONGAKU, KAGEKI, GAKU-ON or the KEGOK, but they are exceptionally expensive, as you would expect from items that take upwards from 100 hours each to

A INDUCTORS.	
Size	Price Ex. UK Vat
	18.00
	14.00
	24.00
	21.00
	31.00
63x74x76 mm	28.00
98x65x83 mm	33.00
68x56x58 mm	24.00
	63x74x76 mm 98x65x83 mm

Order Code	Primary Voltages	Secondary HT Windings	Secondary Heater Windings P	rice Ex. UK Vat	
	Ov/100v/IIOv/120v Ov/220v/230v/240v		Ov-12.6v at I Amp 3.15v-Ov-3.15v at 4 Amp	34.00	
	120v/110v/100w/0v	Ov - 230v at 0.4 Amp	Ov-12.6v,at 1 A	41.00	
TRANS-010		300v- Ov- 300v at	3.15v - 3.15v at 4 Amp 12.6v - Ov at 1.5A	46.00	
	100w/110w/120v	60mA		#7Tube Pre-am with 50H choke	
				input filter	
TRANS-005	Ow/100v/110v/120v Ow/100v/110v/120v	Ov - 290v at 40mA	12 .6v-0v at 1 .5A Ov - 6.3v at 300mA	26.00	
TRANS-025		310v-244v-0v-244v-310 at 320mA	/3.15v -Ov-3.15v at 4.5 Amp	72.50	
TRANS-060	120v/110v/100v/0v	v390v-0v-390v at 200 mA	3.1 5v-0v-3.1 5v at 1 .2Amp, 7v at 3A. 7v at 3A. 5v at 2A	86,70	
TRANS-030			3.15v-0v-3.15vat2.5A.	95.60	
	100v/11 0v/120v		7.0v-0v at 2A, 7.0v-0v at 2A, 5.0v-0v at 3A, KiT 3.15v-0v-3.15v at 750mA	for KIT ONE &	
TRANS.ON	1120-/110-/100-/0-	200m.0v.200v.et 200mA	170-0u at 60m4 7 0u-0u at		

1 UNIVERSAL OF 150 M 1 LON 100 M 0 A 220 A 22 C C O IIIA		
0v/100v/110v/120v170v at 50mA	7v at 3A, 7v at 3A, 5v at 2A	
TRANS-030 120v/110v/100v/0v 425v-0v-425vat220mA	3.15v-0v-3.15vat2.5A. 95.60	
100v/11 0v/120v	7.0v-0v at 2A, 7.0v-0v at 2A, for KIT ONE &	
	5.0v-Ov at 3A, KIT THREE MONO	
	3.15v-0v-3.15v at 750mA channel, 300B output valves	
TRANS-060120v/110w/100v/0v390v-0v-390v at 200mA		
100w/110w/120v	3A, 7.0- Ov at 3A, 5v - Ov at	
	2A. For KASSAI replica.	
	3,15v-0v-3,15v at 1,2A 300B output valves	
TRANS-061120v/110v/100v/0v 380v-0v380vat	150v-0vat 150mA, 10v-0v . 137.00	
100v/110v/120v 200mA	3.25A 10v-0vat3.25A	
	5v- Ov at 3A 5v - Ov at 3A For ONGAKU	
	5v - Ov at 3A, 5v - Ov at 3A reolica.	
	6.3v - 0.6.3v at 1.25A output 211	
	valves	

On a more general index, it is important to understand the specialised nature of the design and manufactures of small design continued to the control of small design control

AUDIO NOTE DRIVER, INTERSTABLE & PRE-AMPLIFIER DUTPUT TRANSFORMERS.
Here is a product group that you do not see advertised every day! As usual we start small with the intention to grow audiciby.

On offer initially is a pre-amplifier output transformer, it should be usable in my friend Diego Nardii. WOT (With Output Transformer) pre-amplifier from Sound Practices, we shall be using it in the forthcoming MS pre-amplifier. Silver wired versions with nickel cores are under preparation, as are more intertains and input transformers.

	CONTRACTOR OF CO				
Туре	Order Code		Standing Current	Suggested	UK Reta
Pre-amplifie output	TRANS-OI	600 Ohms	(where applies) 30 mA for Paralleled operation E182CC, 12	valves 5687, 6SN7 BH7	Price Ex. V. 96.0

Driver TRANS-012 IOKOhm SE IOKOhm 80mA 2A3, 3008 transformer Centre tapped

transformer Centre tapped to the Section Secti

I am all for protecting the environment and not just spainst bad sounding amplifiers (1), so we have to like with the increases, however regardless of these, the Audio Note paper in oil capacitors remain the premium choice for single-ended triode amplification.

To bridge the price and performance gap between the aluminium foil and copper foil caps introducing a range of tin foil paper in oil capacitors, available from now.

Order Code	Value	Maximum DC Voltage	Size	Price Ex. UK V
CAP-6984	2.2mF	50 volt	21x9 mm	11.6
CAP-6804	0.1 mF	200 volt	32xl 1 mm	9.8
CAP-6903	0.56mF	200 volt	25x36 mm	10.5
CAP-6110	0.00tmF	400 volt silver leadoutwires	21x9 mm	9.1
CAP-6130	0.0028mF	400 volt silver leadoutwires	21x9 mm	9.1
CAP-6180	0.0082mF	400 volt silver leadoutwires	21x9 mm	9.1
CAP-6210	0.01mF	400 volt silver leadoutwires	21x9 mm	9.1

CAP-6230	0.015mF	400 volt	21x9 mm	9.14
CAP-6255	0.022mF	400 volt silver leadoutwires	35xiO mm	9.14
CAP-6268	0.033mF	400 volt silver leadoutwires	2000 1 mm	9.14
CAP-6280	0.047mF	400 volt silver leadoutwires	32xl 1 mm	9.14
CAP-6737	0.082mF	400 volt	33x14 mm	9.14
CAP-6806 CAP-6820	0.1mF 0.12mF	400 volt silver leadoutwires 400 volt	33x14 mm	9.14
CAP-6830	0.12mF	400 voit 400 voit silver leadoutwires	33x14 mm 34x16 mm	9.14
CAP-6840	0.15mF	400 voit silver leadoutwires 400 voit silver leadoutwires		
CAP-6852	0.16mF	400 volt silver leadoutwires	32x16 mm 35x13 mm	9,14
CAP-8880	0.22mF	400 voit suver isadourwires	43x18 mm	9.14
CAP-6882	10.:33mF	400 volt silver leadoutwires	43x18 mm	10.85
CAP-6920	0.47mF	400 volt silver leadout wires	36x25 mm	11.75
CAP-6942	0.68mF	400 volt silver leadoutwires	63x22 mm	13.26
CAP-6959	ImF	400 volt silver leadoutwires	53x24 mm	14.65
CAP-6970	1.4mF	400 volt	70x24 mm	16.38
CAP-6006	0.00018mF	630 volt	17x9 mm	9.94
CAP-6020	0.0004mF	630 volt	20x9 mm	9.94
CAP-6181	0.00082mF	630 volt	20x9 mm	3.94
CAP-6120	0.0015mF	630 volt	1 7x9 mm	9.94
CAP-6150	0.0047mF	630 volt	20x9 mm	9.94
CAP-6220	0.012mF	630 volt	21x11 mm	9.94
CAP-6235	0.015mF	630 volt	21x11 mm	9.94
CAP-6257	0.022mF	630 volt silver leadoutwires	20x10 mm	9.94
CAP-6270	0.033mF	630 volt	32x11 mm	9.94
CAP-6275	0.039mF	630 volt	32x11 mm	9.94
CAP-6283	0.047mF	630 volt	33x14 mm	9.94
CAP-6288	0.056mF	630 volt	33x15 mm	9.94
CAP-6290 CAP-6295	0.058mF	630 volt	33x14 mm	9.94
CAP-6295	0.060mF	630 volt 630 volt	33x14 mm	9.94
CAP-6715	0.065mF 0.071mF	630 voit	33x16 mm 33x16 mm	9.94
CAP-6715	0.071mF	630 voit	33x16 mm	9.94
CAP-6722	0.072mF	630 voit	33x16 mm	9.94
CAP-6724	0.074mF	630 volt	33x16 mm	9.94
CAP-6725	0.075mF	630 volt	33x16 mm	9.94
CAP-6730	0.078mF	630 volt	33x16 mm	9.94
CAP-6741	0.082mF	630 volt	33x16 mm	9.94
CAP-6808	0.1mF	630 volt	34x16 mm	9.94
CAP-6832	0.15mF	630 volt silver leadoutwires	42x16 mm	9.94
CAP-6840	0.18mF	630 volt	43x18 mm	9.94
CAP-6854	0.22mF	630 volt	52xl9 mm	7.75
CAP-6855	0.22mF	630 volt silver leadoutwires	52xt9 mm	10.85
CAP-6875	0.27mF	630 volt	53x22 mm	10.85
CAP-6882	0.33mF	630 volt	52x22 mm	10.85
CAP-6890	0.36mF	630 volt	43x25 mm	10.85
CAP-6900	0.39mF	630 volt	52x26 mm	10.85
CAP-6922	0.47mF	630 volt silver leadoutwires	52x26 mm	11.65
CAP-6944	0.68mF	630 volt silver leadoutwires	71x25 mm	13 85
CAP-6960	1 mF	630 volt silver leadoutwires	70x30 mm	18.75
CAP-6245	0.018mF	1000 volt	32xd 1 mm	11.85
CAP-6856	0.22mF	1000 volt	56x26 mm	13.65
CAP-6906 CAP-6945	0.39mF	1000 volt	61x26 mm	15.85
CAP-6945 CAP-6965	0.68mF 1.2mF	1000 volt 1000 volt	52x32 mm 72x40 mm	17.15 21.25
CAP-6858	0.22mF	1000 voit 1600 voit	72x40 mm 60x26 mm	16.45
CAP-6860	0.22mF	2000 volt	70x29 mm	18.75
CAP-7510	0.imF	4000 volt	Square can with	28.75
CAF-7510	U.mr	4000 YOR	porcelan	28.75
			insulators	
			45x45x1 08mm	
			high	

AUDIO NOTE PAPER IN OIL TIN FOIL SIGNAL CAPACITORS.

compliment the range of paper/oilsignal capacitors we will be offering an increasing range on es, starting with the values listed below; I feel that the tin foll is better than alu-foll for most lications, and i recommend that you for them. All Audio Note tin foll signal capacitors have

Value	Maximum DC	Voltage	Siz
0.0lmF	630volt	21x10mm	11.6
0.047mF	630 volt	33x14 mm	11.6
0.lmF	630 volt	34x16 mm	12.9
0.15mF	630 volt	42x18 mm	12.9
0.22mF	630 volt	52x20 mm	14.9
0.47mF	630 volt	52x26 mm	18.2
	0.0lmF 0.047mF 0.lmF 0.15mF 0.22mF	0.0lmF 630 volt 0.047mF 630 volt 0.lmF 630 volt 0.15mF 630 volt 0.22mF 630 volt	0.0tmF 630volt 21x10mm 0.047mF 630 volt 33x14 mm 0.1mF 630 volt 34x16 mm 0.15mF 630 volt 42x18 mm 0.22mF 630 volt 52x20 mm

AUDIO NOTE PAPER IN OIL COPPER & SILVER FOIL SIGNAL CAPACITORS.

Order Code	Value	Maximum DC Voltage	Size	Price Ex. UK Vat
	0.001mF	630 volt	23x9 mm	15.55
CAP-7610	0.0028mF	630 volt	23x9 mm	15.55
CAP-7620	0.0082mF	630 volt	23x9 mm	15.55
CAP-7630	0.0lmF	630 volt	23x9 mm	16.15
CAP-7640	0.022mF	630 volt	30x9 mm	17.75
CAP-7650	0.047mF	630 volt	28x16 mm	19.35
CAP-7660	0.1 mF	630 volt	33x22 mm	20.65
CAP-7670	0.1 5mF	630 volt	35x22 mm	22.15
CAP-7680	0.22mF	630 volt	56x25 mm	26.45
CAP-7690	0.33mF	630 volt	35x30 mm	30.65
CAP-7700	0.47mF	630 volt	56x38 mm	35.05
CAP-7710	ImF	630 volt	65x44 mm	54.15
AUDIO NOTE S	ILVER FOIL PAPER	IN OIL CAPACITORS.		
Order Code	Value	Maximum DC Voltage	Size	Price Ex. UK Vat
CAD 7000	0.047	000	44-46	45.00

CAP-7802 0.047mF 630 volt CAP-7804 0.1 mF 630 volt CAP-7806 0.15mF 630 volt CAP-7810 0.22mF 630 volt CAP-7820 0.47mF 630 volt

Order Code	Value	Maximum DC Voltage	Price Ex. UK Vat
CAP-8005	0.0lmF	500 volt	177.00
CAP-8010	0.02mF	500 volt	211.75
CAP-8015	0.05mF	500 volt	346.75
CAP-8020	0.imF	500 volt	645.75
CAP-8025	0.2mF	500 volt	995.75

Order Code	Value	Maximum DC Voltage	Size Price	Ex. UK Vat
CAP-7515	2mF	400 volt	30x40x55 mm	26.75
CAP-7518	2mF	630 volt	35x45x72 mm	33.65
CAP-7520	2mF	1000 volt	45x46x72 mm	41.75
CAP-7530	2mF	1500 volt		43.25
CAP-7540	2mF	1600 volt	50x70x72 mm	45.95
CAP-7550	4mF	flov 008		44.15
CAP-7551	4mF	1000 volt	45x45x120 mm	49.95
CAP-7553	4mF	2500 volt	70x70x120 mm	265.75
CAP-7560	8mF	800 volt		61.05
CAP-7570	IOmF	1000 volt	70xl00xl00 mm	98.75
CAP-7575	12mF	1000 volt	70x100x120 mm	109.95
CAP-7577	12mF	1600 volt	100x100x120 mm	136.75

AUDIO MOTE ACID & CLORIDE FREE SILVER SOLDER.
The best solder we have been able to find, does not contaminate the junction, which over time is junction resistance. Used in all our amplifiers from 0TO to the midthy GAKU-ON.

Order Code	Weight/Length	Price Ex. UK Vat
AN-SOLDER-OI	50 grammes or about 9 meter 1 mm diameter	19.95
AN-SOLDER-02	1 kilo roll of 1 mm diameter	210.65

AUDIO NOTE CABLES A WIRES.

We are proud to offer the AUDIO NOTE range of high quality copper and silver coax, speaker and wiring

Audies, which depending on the overall price of the project, will do justice to any hiff system, regardless

of price.	namy on the order pri	oe of the project, and so justice to	any non ayangin, regardin
Solid 99.99% Pure	AUDIO NOTE Silver W		
Order Code	Wire Gauge	Insulation Material	Price Ex. UK Vs
AN-WIRE-005	0.05mm	Polyurethane	16.75
AN-WIRE-010	0.2mm	Polyurethane	22.75
AN-WIRE-015	0.35mm	ML	24.95
AN-WIRE-020	0.6mm	ML	27.85
AN-WIRE-025	0.8mm	ML	31.75
AN-WIRE-030	1mm	ML	36.75

The above solid silver wires are suitable for low level interstage transformers, output transformers, power supply chokes, inductors for speaker crossovers, both active and psaste or for internal wiring is tonearms, amplifiers etc. A wider range of gauges is stocked, so enquire about required gauge, it may

AUDIO NOTE SIN					
Order Code	Wire Gauge/Stands	Colour	Insulation	Price I	Ex. UK Vat
AN-WIRE-100	0.09 mm 15 strand	RED	Polyurethane 6	coats	24.45
AN-WIRE-110	0.09 mm 15 strand	WHITE	Polyurethane 6	coats	24.45
AN-WIRE-120	0.09 mm 15 strand	GREEN	Polyurethane 8	coats	24.45
AN-WIRE-130	0.09 mm 15 strand	BLACK	Polywerthane 6	coats	24.45

This is the wiring recommended for all hardwired topflight projects, the same wire is used in the AN-V interconnect and as signal wiring were in all Mr. Kondos amplifiers and pre-amplifiers, available in red, white, green and black. We will sell as little as 25cm of each colour, so buy a little and see if it makes a difference in your amplifier, a good place to start is on the Phono or CD input.

The ultimate wire for rewiring your tonearm, made from 3 individually insulated strands of 0.05mm Audio Note 99.99% silver wire, this is not just the best sounding internal wire, it is also the most flexible, so why not upgrade the sonic performance of your tonearm dramatically with a rewire?

 Order Code AN-WIRE-300
 Wire Gauge/Strands
 Colour Clear/Silver
 Insulation Polyurethane 6 coats strands
 Price Ex. UK Vat Polyurethane 6 coats price per meter

Order Code	Type/Colour	Construction	Price Ex. UK Vat
N-CABLE-100		symmetrical 6N copper litz coax,	15.32
N-CABLE-150	AN-C red	symmetrical OFHC copper litz coax,	29.79
N-CABLE-200	AN-S dark grey	symmetrical 99.99% silver litz coax. 15 strands	0.09 mm 84.25
N-CABLE-250	AN-V silver grey	symmetrical 99.99% silver litz coax 15 strands 0	.09 mm 152.35
IN-CABLE-300	AN-Vx silver grey	symmetrical 99.99% silver litz coax 20 strands 6	.09 mm 382.98
		Dual symmetrical 99.99% silver litz coax 60 stra	

HI-FI WORLD SUPPLEMENT

All Audio Note interconnect/coax cables are priced per stereo meter.

	Type/Colour Code		Ex UK Vat
AN-WIRE-500	AN-D green or red	single conductor 6N copper speaker wiring	6.85
AN-WIRE-550	AN-B blue white writing	double strand, screened 6N speaker wire	12.34
AN-WIRE-600	AN-L blue black writing	double strand, screened 6N litz copper speaker wire	25.11
AN-WIRE-650	AN-SP silver	single core 15 strand 99.99% litz silver speaker wire	106.38
AN-WIRE-700	AN-SPx silver	single core 20 strand 99.99% litz silver speaker wire	382.98
AN-WIRE-800	AN-SPz Brown	Single core 4 internalconductor 60 strand 99.99% silver speaker wire	2,085.11

DIO NOTE HIGH QUALITY STEPPED ATTENUATORS & SWITCHES.

Order Code	Type	Value	Price Fx. LIK Vat
SWITCH-260	Stereo Potentiometer/Attenuator	10KOhms	221.75
SWITCH-265	Stereo Potentiometer/Attenuator	50KOhms	221.75
SWITCH-270	Stareo Potentiometer/Attenuator	100KOhms	237.75
SWITCH-270A	Stereo Potentiometer/Attenuator	250KOhms NEW	262.55
SWITCH-270B	Stereo Potentiometer/Attenuator	500KOhms NEW	267.45
SWITCH-280	2 Channel switch	6 - way adjustable	98.75
SWITCH-290	4 Channel switch	6 - way adjustable	. 124.75

DIO NOTE HIGH QUALITY CERAMIC VALVE BASES.

All of our valve bases are of the highest possible quality, made from steatite and using the best met parts from alloys which retain their spring tension around the valve pin for longer. They are recommended as upgrades to most old valve amplifiers and should be an essential part of any DIY

Order Code Type/Valve	Mounting	Pin Contacts 8	rice Ex.
		Plating	UK Vat
VBASE-185 4-pin UX4 for 3008/2A3/801A	Chassis	Gold	8.25
VBASE-180 4-pin UX4 for 300B/2A3/801A	Chassis	Nickel	7.25
VBASE-170 4-pinUX4WE-typefor3008/2A3/801A	Chassis	Silver	14.75
VBASE-175 4-pin UX4 WE-type with bayonet mount	ing	Chassis	Silver48.
VBASE-190 4-pinJumbo4 for211/VT4C/845	Chassiswithbayonet	Silver/chrome	159.95
VBASE-150 5-pin UY5 for 807	Chassis	Gold	9.75
VBASE-100 7-pin B7 for 6X4, QA2	PCB .	Silver	6.15
VBASE-105 7-pin B7 for 6X4, OA2	PCB	Gold	7.85
VBASE-110 7-pin B7 for 6X4, OA2	Chassis from above	Silver	6.75
VBASE-115 7-pin B7 for 6X4. OA2	Chassis from above	Gold	7.95
VBASE-160 8-pin U8X for EL34, 6550, 5U4G. GZ34,	Chassis	Silver	5.65
VBASE-165 8-pin U8X for EL34, 8550, 5U4G, GZ34.		Gold	5 55
VBASE-005 9-pin 89 for ECC83, ECC88, 5687, 6350, etc.	PC8	Silver	3.85
VBASE-010 9-pin B9 for ECC83, ECC88, 5687. 6350, etc.	PC8	Gold	5.75
VBASE-015 9-pin B9A for ECC83, ECC88, 5687, 6350 etc. etc.	Chassis from above	Silver	4.45
VBASE-020 9-pin 89A for ECC83, ECC88, 5687, 6350, etc. etc.	Chassis from above	Gold	6.75
VBASE-025 9-pin B9A for ECC83, ECC88, 5687, 6350, etc. etc.	Chassis from below	Silver	4.95
VBASE-030 9-pin B9A for ECC83, ECC88, 5687, 6350, etc. etc.	Chassis from below	Gold	7.15
VBASE-1000 Topcap	For 807 pentode etc	Nickel	9.75
You may want to start your project with less overall of	net and for this purn	nse we can offer	the following

Order Code	Type/ Valve	Mounting	Price Ex. UK Vat
VBASE-218	4-pin for 2A3, 300B, bakelite	Chassis below, solder	eves 2.25
VBASE-215	7-pin for OA2. 6X4.	PCB	2.55
VBASE-205	8-pin for EL34, 6550, KT86, 6L6G	Chassis with bracket	1.45
VBASE-3001	9-pin for ECC83, ECC88, 5687, 6350	Chassis with shroud	1.85

Price Ex. U	K					Cinarate Lacing
			Length			Vat
CON-800	AN-421	1	25.5 mm	Wrap-round	Screw-in bolt	1.41
CON-801	AN-422	1	17.4 mm	Wrap-round	Screw-in bolt	1.41
CON-802	AN-423	1	22.6 mm	Solder slot	Screw-in	1.41
CON-803	AN-424 NEW!		21.0 mm	Wrap-round	Screw-in	1.51
CON-805	AN-425 NEW!	1	12 mm	Wrap-round	Screw-in	1.71
CON-806	AN-426 NEW!		23.4 mm	Wrap-round	Screw-in bolt	1.86
CON-807	AN-427 NEWI	1	17 mm	Wrap-round	Screw-in bolt	1.71
CON-810	AN-452	2	Adjustable, 1 7mm	Solder slots	Dual bolt screw-in	
CON-811	AN-453	3	Adjustable, 24mm	Solder slots	Dual bolt screw-in	3.05
CON-810A	AN-454 NEW!	4	Adjustable, 3 1 mm	Solder slots	Dual bolt screw-in	4.13
CON-813	AN-455	5	Adjustable, 32mm	Solder slots	Dual bolt screw-in	4.91
CON-817	AN-458	8	Adjustable, 58mm	Solder slots	Dual bolt screw-in	5.79
CON-820	AN-460	10	Adjustable, 72mm	Solder slots	Dual bolt screw-in	7.31
CON-832	AN-472 NEW!	2	Fixed, 8mm	Solder slots	Dual screw-in	3.07
CON-833	AN-473 NEW!	3	Fixed, 8mm	Solder slots	Dual screw-in	3.39
CON-835	AN-475 NEW!	5	Fixed, 8mm	Solder slots	Dual screw-in	4.91
CON-836	AN-476	6	25mm/45m	Solder slots	Screw-in bolts	5.35
CON-839	AN-479	9	25mm/66m	Solder slots	Screw-in bolts	7.53
CON-841	AN-481 NEW!	11	Fixed, 8mm	Solder slots	Dual screw-in	9.21

otners.			
Standard Sto	ck Items	*	
Order Code	Valve Type		ice Ex.
WILLIE DOOR	F0000W 01100WW 0000		UK Vat
	E83CC/1 2AX7WA/7025 E83CC Super/1 2AX7WB	Sovtekdouble triode	2.95
		Sovtek, high gain super low noise	3.95
VALVE-0000	E83CC01/12AX7WXT	Sovtek, super low noise, low microphony audio version of WA	2.85
VALVE-0080	60794	General Electric, USA, double triode, low gain ECC83	
ANTAC-0000	60/2A	type, exceptional sounding used in ONGAKU, M7Tube Silver, KEGON probably best sounding ECC83	11.45
VALVE-0081	12AY7	GE, USA low microphony version of 6072A	13.45
	E88CC/6922/6DJ8WA/7308	Soviek double triode, low microphony	4.75
VALVE-1239		Philips/ECG USA, low microphony & noise, good sound	5.45
VALVE-0120	EF86/6267/Z729	Russian made version of this small pentode	6.45
	ECC82/12AU7/5814a	Philips/ECG USA, double triode, mil spec	5.95
VALVE-0142	ECC82	Yugoslavia, best ECC82 available from new production	4.95
VALVE-0160	6SN7GT Russian	double triode, USX base	3.75
VALVE-0180	6SN7WGTA Sylvania	double triode original US-made, low microphony, super	
		sounding	10100
VALVE-0200	6SL7GT	Russian double triode, USX base	3.25
VALVE-0210	6SJ7WGT	Philips/Sylvania USA Small signal pentode	7.75
VALVE-0220	6350WA	US-made double triode, fine driver	10.35
VALVE-0240	5687WB Sylvania USA	double triode, powerful driver used in ONGAKU, KEGON etc.	9.85
VALVE-0260	E182CC/7119/7044 General Electric USA	double triode very powerful driver, pin-equivalent of 5687WB	14.75
VALVE-0280		Sovtek triode-pentode	2.65
VALVE-0300	EL84/8805	Russian small power pentode	1.55
	EL84M/68Q5WA	Russian small power pentode, mil spec version	4.51
VALVE-0340		Sovtek small power tetrode	2.45
VALVE-0360		Russian medium power pentode	2.75
	5881/KT66/6L6WGC	Sovtek medium power tetrode	4.51
VALVE-0341		Philips/Sylvania, the real McCoyll	16.75
VALVE-0420		Sovtek medium power tetrode, standard base	5.55
	6CA7/EL34 Fat Buffl	Sovtek power tetrode	8.85
VALVE-0460		Sovtek power pentode	6.45
VALVE-0231		Russian power tetrode	14.75
VALVE-0232		Russian power tetrode	16.75
VALVE-0235		Slovakian power tetrode	16.75
VALVE-0236		Czech power tetrode	19.95
VALVE-0239		Yugoslav power pentode	21.65
VALVE-0480		power triode, Audio Note branded and tested to our specification, Chinese manufacture	56.45
VALVE-0482		Sovtek, this is a seriously good 300B version, both in terms of bench performance and sound	65.15
VALVE-0500		power triode, Audio Note branded and tested to our specification, Chinese manufacture	29.45
VALVE-0520		power triode, Audio Note branded, tested and tried Chinese made	33.45
VALVE-0540		powerful Russian made regulator, indirectly heated triode	24.65
VALVE-0560		strong Russian regulator, indirectly heated triode directly heated small power triode, Chinese made	6.45
	Innovations Second Audio Amplifiers	unactry reason small power those, Chinese made	17.95
		HT-rectifier	3.25
		HT-rectifier	2.25
		HT-rectifier	3.95
		HT-rectifier	8.75
		HT-rectifier	49.95
		HT-rectifier, equivalent to GZ32/34, but better sounding in my opinion	9.55
		Very powerful HT-rectifier, 2,500volt at 100mAl	24.55
VALVE-0760		HT-rectifier, very good for pre-amplifiers, 7-pin base, Russian reverse pin version	3.75

HT-rectifier, for pre-amplifiers & power amplifier 4.25 front-ends, UBX base, Russian made

This is definitely the best sounding resistors available, forget the VISHAY, which may be ok in high feedback transistor amplifiers, but in our opinion quite uncomplimentary to the qualities of real Audio Amplification (i.e. directly heated triold amplifiers numing feedback tree in single-ended Class A), this is where you will need the turnishum film resistor for the best results.

Firstly to compliment the range of Audio Note 1 watt tantalum resistors we have started stocking a liminumber of 2 watts, namely, 1 Meg, 1M5 and 2Meg.

Order Code Wattage Value Tolerance Price	Ex. UK Vat
RES-0326 6 watt 47R 5%	0.86
RES-0330 6 watt 100R 5%	0.86
RES-0346 6 watt 470R 5%	0.86
RES-0360 6 watt 1 K0 5%	0.86
RES-0369 6 watt 2K2 5%	0.86
RES-0380 6 watt 15K 5%	1.32
RES-0381 6 watt 20K 5%	1.32
RES-0382 9 watt 100R 5%	1.24
RES-0384 9 watt IK5 5%	1.24
RES-0386 9 watt IK8 5%	1.24

BLACK GATE ELECTRON TRANSFER, High Performance, Graphite foil capacitors.

Order Code Price Ex. UK Vat	Value	Voltage	BG-Type	Recommended Use
CAP-9000 47mF	25volt	PK		
CAP-9005 33mF	35volt	PK	Anywhere	1.65
CAP-9010 0.47mF	50volt	PK	Anywhere	1.75
CAP-9015 1mF	50volt	PK	Anywhere	1.05
CAP-9020 2.2mF	50volt	PK	Anywhere	1.12
CAP-9025 3.3mF			Anywhere	1.23
CAP-9025 3.3mF	50volt	PK	Anywhere	1.38
CAP-9030 4.7mF	50volt	PK	Anywhere	1.68
CAP-9035 10mF	50volt	PK	Anywhere	1.87
CAP-9040 22mF	50volt	PK	Anywhere	2.68
CAP-9045 22MF	1 Bvolt	Standard	Anywhere	2.82
CAP-9050 33mF	1 6volt	Standard	Anywhere	3.42
CAP-9055 47mF	1 6volt	Standard	Anywhere	4.11
CAP-9060 330mF '	1 6volt	Standard	Arrywhere	6.68
CAP-9065 10mF	50volt	Standard	Anywhere	2.97
CAP-9070 47mF	50volt	Standard	Anywhere	4.41
CAP-9075 100mF	1 Byolt	Standard	Anywhere	4.73
CAP-9080 100mF	50volt	Standard	Anywhere	5.47
CAP-9085 220mF	50volt	Standard	Anywhere	10.41
CAP-9090 10mF		Standard	Anywhere	3.71
CAP-9095 22mF	100volt	Standard	Anywhere	6.31
CAP-9100 47mF		Standard	Anywhere	8.54
CAP-9105 100mF	100volt	Standard	Anywhere	7.75
CAP-9110 220mF	100volt	Standard	Anywhere	22.18
CAP-9115 1000mF	16volt	Standard	Anywhere	8.22
CAP-9120 1000mF	50volt	Standard	Anywhere	24.55
CAP-9125 220mF	1 Evolt	Standard	Anywhere	4.35
CAP-9130 470mF	16volt	Standard	Anywhere	6.35
CAP-9135 2200mF	16volt	Standard	Anywhere	13.45
CAP-9140 10.000mF	80volt	Standard	PSU smoothing	234.65
CAP-9145 4700mF	16volt	Standard	Anywhere	14.25
CAP-9150 47mF + 47mF		SKz-Type	PSU filter capacitor	85.95
	550y su	nge		
CAP-9155 100mF +100mF	500volt- 550v su		PSU filter capacitor	101.95
CAP-9160 100mF	500volt 550v su	- SKz-Type	PSU filter capacitor	72.75
CAP-9165 220mF + 220mF	350volt- 400v su	SKz-Type	PSUffirercapacitor	92.65
CAP-9170 100mF + 100mF	350volt- 400v su	SKz-Type	PSUffitercapacitor -	75.35
CAP-9175 100+100mF	500volt-	WKz-Type	PSU filter capacitor	195.35
CAP-9180 47+47mF		- WKz-Type	PSU filter capacitor	159.85
CAP-9185 100mF		- WKz-Type	PSU filter capacitor	144.65
CAP-9190 100+100mF	550v sur	ge WKz-Tyne	PSII filter canacitor	161.74

CAP-9195 220+220mF		-WKz-Type	PSU filter capacitor	181.9
CAP-9200 22mF	400v su	VK-Type		
CAP-9205 150mF		VK-Type	Decoupling or filter capacitor PSU filter capacitor	18.9
CAP-9210 0.47mF	50volt	F-Type		
CAP-9215 22mF	6.3volt	F-Type	Low ESR, Low impedance use anywhere	1.1
CAP-9220 100mF	6.3volt	F-Type	As above As above	1.2
CAP-9225 220mF	6.3voit	F-Type	As above	1.5
CAP-9230 2200mF	6.3volt	F-Type	As above As above	2.1
CAP-9235 47mF	1 fivolt	FK-Type		
			Ultra low ESR version, comparable to film caps	7.1
CAP-9240 100mF	16volt	FK-Type	Ultralow ESR version comparable to film caps	13.7
CAP-9245 220mF	1 Svolt	FK-Typr	Ultra low ESR version, comparable to film	19.9
CAP-9250 100mF	25volt	FK-Type	As above	14.2
CAP-9255 220mF	25volt	FK-Type	As above	21.4
CAP-9260 100mF	50volt	FK-Type	As above	15.7
CAP-9265 1000mF	50volt	FK-Type	As above use anywhere	58.7
CAP-9270 2200mF	35volt	FK-type	As above use anywhere	55.7
CAP-9275 2200mF	63volt	FK-Type	As above use anywhere	101.4
CAP-9280 100mF	100 volt	FK-Type	As above use anywhere	32.8
CAP-9285 2.2mF	50volt	C-Type	For circuits with DC potential difference	2.0
CAP-9290 4.7mF	50volt	C-Type	For circuits with DC potential difference	3.3
CAP-9295 6.8mF	50volt	Bioolar	For loudspeaker crossover networks	12.6
CAP-9300 10mF	50volt	Bipolar	as above	16.8
CAP-9305 22mF	50volt	Bipolar	as above	23.9
CAP-9310 47mF	50volt	Bigolar	as above	36.9
CAP-9315 0.47mF	50volt	BG-Nx Type	For PSU decoupling	12.3
CAP-9320 220mF	6.3volt	BG-Nx Type	For super low noise PSU's	11.8
CAP-9325 100mF	16volt	BG-N Type	For super low noise PSU 's	24.6
CAP-9330 470mF	16volt	BG-N Type	as above	28.9
CAP-9335 4700mF	35volt	BG-N Type	as above	210.4
CAP-9340 1mF	50volt	BG-N Type	as above	5.4
CAP-9345 4.7mF	50volt	BG-N Type	as above	6.6
CAP-9350 10mF	50volt	BG-N Type	as above	7.5
AP-9355 47mF	50volt	BG-N Type	as above	13.7
AP-9360 100mF	50volt	BG-N Type	as above	20.3
AP-9365 1000mF	50volt	BG-N Type	as above	99.9
AP-9370 2200mF	100volt	BG-N Type	as above	423.3

CAP-9740	100+100mF	350 volt	Power supply filtering	19.95	
CAP-9750	220+220mF	350 volt	Power supply filtering	29.95	
CAP-9901	47mF	500 volt	Power supply filtering	12.95	
CAP-9910	47+47mF NEW	500 volt	Power supply filtering	19.95	
CAP-9930	100+100mF	500 volt	Power supply filtering	29.95	
CAP-9950	220mF NEW	500 volt	Power supply filtering	29.95	
CAP-9960	220+220mF NEW	500 volt	Power supply filtering	39.95	
CAP-9970	330mF NFW	500 volt	Power supply filtering	34.95	
CAP-9680	2.200mF	100 volt	Power supply filtering	34.95	
CAP-9500	4.700mF	6.3 volt	Heater filtering	4.95	
CAP-9670	100mF	100volt	Bypass anywhere	2.95	
CAP-9550	100mF	50 volt	Bypass anywhere	1.95	
CAP-9660	220mF	100 volt	Bypass anywhere	8.95	
CAP-9560	220mF	50 volt	Bypass anywhere	2.95	
CAP-9570	470mF	50 volt	Anywhere	5.55	
CAP-9580	22 mF	50 volt	Anywhere	1.15	

We shall continue to expand the range of Cerafine electrolytics over the next few months, so keep an eye on this spacet

Order Code	Impedance	Construction Frame type, PCB mounted Encapsulated type, PCB mounte	Price Ex. UK Var
SWITCH-200	100K0hm Stereo, logarithmic		4.95
SWITCH-210	100K0hm Stereo, logarithmic		d 18.65

A better alternative is the KO-ON volume controls which are used in pre-amplifiers like the MTTube, MTLine, and in a mono version on the Input on the NEIRO, KASSAI, KEGON and GAKU-ON, these are very

Order Code Vat	Impedance	Construction	Price Ex. UK
SWITCH-271	100KOhm Stereo, logarithmic	Encansulated	32.25
SWITCH-272	100KOhm Mono, logarithmic	Large Encapsulated	70.65
SWITCH-273 107.45	100KOhm Stereo, logarithmic	Large Encapsulated, high	quality

Order Code	Impedance	Construction	Price Ex. L
SWITCH-205	100KOhm	Frame type, PCB mounted	
SWITCH-210	100KOhm	Encapsulated type, PCB mounted	
SWITCH-274	100KOhm KO-ON	Encapsulated, PCB mounted	

STANDARD TYPE SWITCHES.						
Order Code	Type IFacility		Price Ex. UK Vat			
SWITCH-020	Standard 16-way, 2 channel adjustable		5.95			

30.65

This switch is adjustable 2 - 5 - way, it has gold plated contacts and a stainless stell ball for best possible corrosion protection and contact. The NO-ON offers a very nice quality sealed switch, 6 way 2 channel at 2 60.55 each.

SIANUANU	ELECTRO	LTTIC CAPAC	TIUNS, GOOD QUARTY STREETS INDUSTRIAL	types.
Order Code	Value	Voltage	Size	Price Ex. UK Vat
CAP-1020	100mF	10volt	18x6mm axial, lbx7mm radial	0.23
CAP-1040	100mF	16volt	15X6 mm axial	0.29
CAP-1080	220mF	16volt	11X8 mm radial	0.31
CAP-1135	220mF	40volt	13X10 mm radial	0.42
CAP-1150	100mF	63volt	13x10mm radial	047
CAP-1080	4700mF	16voit	38x18 mm radial	0.82
CAP-1120	2200mF	50volt	35x18mm radial, 41x16mm axial	0.87
CAP-1200	10mF	160volt	15X10 mm radial	0.56
CAP-1241	22mF	350volt	25x12 mm radial	1.45
CAP-1290	22mF	450volt	41x16 mm axial	1.99
CAP-1260	47mF	385volt	25x21 mm radial	2.46
CAP-1280	56mF	400volt	30x21 mm radial	2.87
CAP-1284	68mF	400volt	30x22 mm radial	2.98
CAP-1297	100mF	400volt	30x25 mm radial	3.76
CAP-1285	220mF	450volt	40x30 mm radial can	6.85
CAP-1304-1	220mF	550volt	112x35mm radial screw terminals	27.65

CON-310/311 AN-GP AUDIO NOTE gold plug 8.51	RCA Plugs.		
CON-307/308 AN-P AUDIO NOTE Solid Silver plug, tefton insulated, non-magnetic25.53		Standard Gold plug AN-C Gold plug 3.6	55 65 51

RCA Sockets.			
Order Code	Туре	Mounting .	Price Ex. UK Vat
CON-030/032	RCA socket nickel plated	Chassis mounted	0.41
	RCA socket gold plated	Chassis mounted	
CON-034/036	AN-CS AUDIO NOTE non-magnetic	teffon insulated	
	socket, gold plated	Chassis mounted	3.65

NC Plugs & Soc	kets.	
on-O50	Type Standard BNC plug	Price Ex. UK Vat 3.45
ON-061	BNC Silver plated socket chassis mounted	2.05
Ni 1		

	de' rossesbannes camie obasses, cuesses rossebannes i citilitatis.	
Order Code	Type/Description	Price Ex. UK Vat
	AUDIO NOTE Banana plug, gold plated, spring loaded tension	2.45
	AUDIO NOTE Loudspeaker Cable spade, silver plated, non-magnet	c 4.65
1.85		
CON-028/03 CON-028-03	9AUD10 NOTE AN-STR Speaker Terminal, chassis mounts, fully gol	ted, red or black2.75 d plated, 4.75
CON-015	non-magnetic red or black Ground Terminal, chassis mounted and nickel plated	1.45
	Order Code CON-080 CON-065 CON-020/03 1.85 CON-028/03 CON-028-03	Order Code Type/Discription ALIDIO NOTE Samma plug, pold plated, spring loaded tension COM-600 ALIDIO NOTE Cashanas plug, pold plated, spring loaded tension COM-CODEO/SCOS ALIDIO NOTE AN-STER plate spake, silver plated, non-magnetic COM-CODEO/SCOS ALIDIO NOTE AN-STER plated Terminal, chasias mocents, nickel pit COM-CODEO/SCOS ALIDIO NOTE AN-STER Speaker Terminal, chassis mocents, fatly pol- comic code-code-scos alidio NOTE AN-STER Speaker Terminal, chassis mocents, fatly pol- mocents.

Our range of components is constantly expanding, as we find new or better suppliers, so stay in tour reading our adverts in Hill World and Hill News.

AUDIO NOTE Moving Call, CD Line & Input Matching Tra

I have received many requests for moving coil, CD and input matching transformers, and since we alresdy make and use these, it might be a good idea to offer them for general sale. Common to all of

5	with a nut fo			ers is that they come in a mumetal screening can with	h a threaded sp
5	Order Code	Туре		Primary/Secondary Impedances - Main Use	Price Ex. UK Va
5			Code		
5	TRANS-465	117687	Brown	3 & 120hm - 100KOhm, copper wired MC matching	51.5
5	TRANS-470	TT7688	Red	15 & 800hm - 100KOhm, copper wired, MC matchin	ng 51.5
	TRANS-460	TT7690	Yellow	3 & 12 Ohm - 100KOhm, copper wired High Quality	78.2
5				MC matching	
	TRANS-455	TT7691	Green	15 & 600hm - 100KOhm, centre tapped copper wire	nd 78.2
5				High Quality,MC-matching	
	TRANS-450	TT7692	Blue	150 & 6000hm - 2K5 & 10K0hm, copper wired High	h 78.2
5				Quality, line matching	
	TRANS-475	TT7693	Violet	25 & 1000hm - 2K6, copper wired High Quality line	78.2
5				matching	
	TRANS-410	TT7694	White	150 -1500hm copper wired High Quality line	101 5
5				matching	
	TRANS-415	TT7694	H	Clear 150-6000hm copper wired High Quality line	101.5
5				matching	
	TRANS-420	TT7695	Silver	150 - 150 Ohm silver wired High Quality line matchi	ino 378.6I
5	TRANS-476	117696	Black	3 & 120hm - 100KOhm silver wired MC matching	378.6

and some Koetsu's, the high versions are meant for Goldring Eroicas, most Denons, Clearar Hul cartridges, the Ikada and a few higher cuput Koetsus.

Order Code	Type	Width/Depth/Height	Price Ex. UK Vat
MWK-005+010	Chassis 1 Aluminium	437x396xl 25mm	£ 84.50
MWK-055+064	Chassis 2 Aluminium	294x396xl25mm	€ 69.50
MWK-005+0101	Chassis 1 Copper	437x396xl25mm	£ 198.50
IMWK-059+010 MWK-300 +305	Chassis 2 Copper KIT ONE/KIT THREE Chassis, mild steel.	294x396x125mm	£ 165.50
MWK-301 + 305	black paint KIT ONE/KIT THREE Chassis mild steel.	400x300x50 mm	£ 78.90
	polished chromed	400x300x50 mm	£ 116.70

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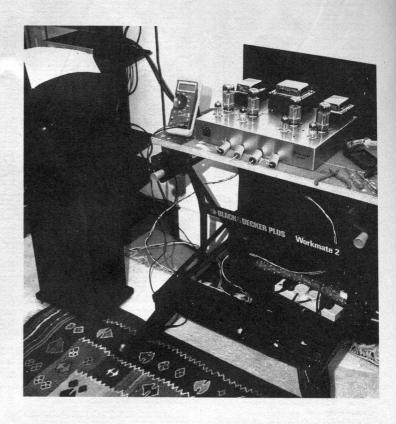




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TWEAKED! - WITH SPECIAL COMPONENTS



Around the world, high quality electronic components for audio work are being produced by specialist manufacturers. Noel Keywood and Jon Marks review some esoteric capacitors and resistors from this field.

omponent quality is ever more widely being identified as an issue affecting sound quality. But prices remain a barrier to widespread commercial usage of the most esoteric items. But not to DIYers, who can upgrade 'at cost'.

Proper audio grade components are truly esoteric items, often with peculiar descriptions, complex performance claims and high prices. They're great for DIYers, providing an opportunity to step up in quality to a level beyond the reach of the mass audio market.

Component quality has always been an issue at Hi-Fi World. We have our own transformers and capacitors made for us and through practical experience have become well aware of the sonic signature of many components, both general purpose and audio grade. And the character of a component invariably comes

through irrespective of working conditions.

But this business is complex. Many budget components sound quite good - carbon film resistors for example. High grade components not meant specifically for audio work do not always sound better - some polypropylene capacitors for instance.

And it can be disastrous to populate an amplifier with a component having a particularly strong signature. One time, every resistor in a K5881 amplifier was misguidedly changed to metal film - it sounded awful, hard and clattery. So this is a mix 'n' match business too.

It is also a decidedly subjective business where notions of absolute correctness are hard to support. Quite often, however, there is a broad consensus, but that's very different to total agreement. A 'hard sound' can suit vinyl, but not CD.

My experience is that differences in component sound quality are easier to discern on a valve amplifier than a solid-state amplifier. This view arises from changing components in a 300B alongside our 36watt Class A design. So we used a K5881 MkII for this report, changing the components shown in the circuit diagram.

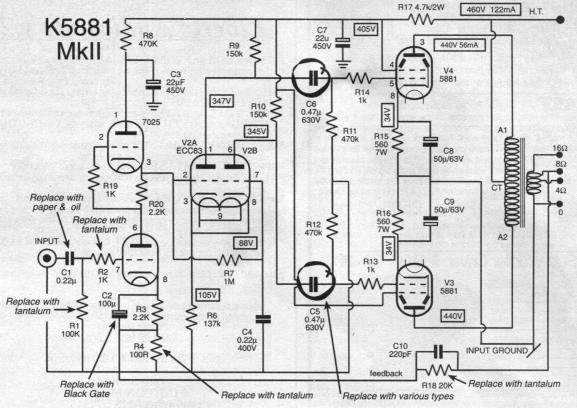
Modern plastic capacitors use a film metallised on both sides. It can be polyester, polycarbonate or polypropylene. The film is usually aluminium, its thickness determining the voltage rating. The Wondercaps tested in this report use metallised film construction.

Audio grade capacitors sometimes use a foil and film construction, which is much bulkier.

Then there's paper-in-oil. This is a rare dielectric type nowadays - we've found one manufacturer in Britain who produces it for military purposes. These capacitors are made by forcing oil into paper under pressure and heating in a sealed tank. It's an old-fashioned method that yields variable results. Paperin-oils can leak (electricity not oil!) but they have a good reputation for sound quality.

Electrolytics provide very high capacitance from small size, but have mediocre performance in most other areas. There are legions of special types as a result. Rubycon make various audio grade specials, like the famous Black Gate. This reputedly uses an electrolyte with a graphite additive, developed by Japanese manufacturer Jelmax.

Carbon film resistors are most common and usually sound pretty good. Metal film types such as Holcos are considered a step up, but for this report we tested tantalum film resistors, manufactured in Japan and imported into Britain by AudioNote.



THE COMPONENTS WE TWEAKED

COUPLING CAPACITORS C5 & C6 - In this position the K5881 kit's standard capacitor is a 0.47µF metallised film polyester capacitor with 400V across it. In its place we soldered in: HOVLAND MUSICAP 0.47µF 600V film and polypropylene foil capacitors; TRT WONDERCAP IµF 425V metallised polypropylene film capacitors; AUDIO NOTE paper-in-oil 0.39µF 600V capacitors.

INPUT CAPACITOR CI - This was replaced with an AudioNote 0.22µF 400V paper-in-oil.

FEEDBACK BYPASS CAPACITOR C2 - This was replaced with a 100µF 6.3V Rubycon Black Gate electrolytic.

INPUT AND FEEDBACK RESISTORS - These were replaced with tantalum resistors.

STANDARD POLYESTER CAPACITORS (56p each)

IM - Tori Amos' vocals and harpsichord were both powerful and smooth, integrated within an acoustic whose size was clearly audible through the Sextet Ils. The grungey electric guitars which join the song in its second half had an attractive 60-a-day roughness to them, which is just as it should be. Individual images hung together in a cohesive sound stage, good tonal balance leading to an evenhanded presentation.

The ebb and flow of piano and strings showed that dynamic contrasts posed these caps no problems, with further proof in the weight of the piano's bottom end and the expressiveness of vocals. Extra bass brownie points were garnered for the focus and impact of the conga on 'Talula' and the drum



machine on 'Professional Widow'.

The acoustic was once

again well fleshed out on Vivaldi's Four Seasons, where imaging was stable, separation good and detail fine. Rhythm and timing were also present and correct, as I found out with the 'Danza Pastorale', its violins tripping along, joined by the drive of the well defined cellos.

NK - Very clear and precise. Typical film capacitor glassiness, close to audio grades but a little less insight, fine detail and

smoothness.



AUDIONOTE PAPER-IN-OIL CAPS (£12.75 each)



Bass immediately stood out for its extra detail, speed, impact, extension and focus. It was as if someone had hit the loudness switch, but instead of fat, bloated lower registers, there was suddenly another octave of hardhitting bass on tap. As a selfconfessed bass-head, the AudioNotes produced the kind of taut, tuneful bass that put a grin straight on my face - the groove factor in the music had just risen a couple of notches on the shake-your-booty meter.

The sound as a whole opened out, different layers within the sound stage becoming more obvious - individual images were now easier to make out within the larger acoustic these capacitors developed. They also showed an overall control and grip which never quashed the vitality of the music, instead enhancing it by making the music easier to listen in to.

There was greater detailing to images as well, giving them a fuller, more three-dimensional feel and knitting them more convincingly into the sound stage. This detailing extended to the treble, with cymbals and strings benefiting from

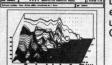
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impressive tonal subtlety and insight.

One major difference between the AudioNotes and the standard capacitors was a softer midrange that was less forward and incisive, giving Rock a mellower character. NK - Always different from synthetic film capacitors, these paper-in-oils soften out the mid-band a little but give enormous amounts of clean high frequency detail. Most surprising was their significant extra bass extension, with improved impact and raised level.

HOVLAND MUSICAPS (£12.86 each)

The Hovlands' midrange is similar in presentation to the standards' in its forwardness, but has a delicacy of detail closer to the paper-in-oil capacitors. Tonally, the Musicaps had a wider palette to paint from as well, with violins and cymbals in particular coming across more realistically.

While the Hovlands' bass was tight, detailed and fast, it lacked the sheer weight and impact that the AudioNotes possessed. This meant that acoustics were rendered on a smaller scale, the sound stage missing out on some of the width and depth that had been discernible with the paper-in-oils.

The overall balance of the music tipped away from the visceral of the AudioNotes towards the analytical, becoming a little less engaging in the process. Rock fans



might well go for this approach with its crisp, precise speed though. And the way images stood out cleanly in the acoustic means that these caps will never sound confused, even on the heaviest of mixes.

NK - Similar in basic

presentation to the standard polyesters, but with stronger outlining, more detail and more upper midband projection.

TRT WONDERCAPS (£5.50 each)

These capacitors continued the plastic family tradition of forward and incisive midrange, as the likes of Grace Jones, the Chemical Brothers and Vivaldi proved. With the latter there was a broader sound stage and deeper bass than had been the case with the Musicaps. The music flowed along rhythmically, these caps showing off their prowess in the timing area with an impressively foot-tapping rendition of 'Setting Sun'. Detail was abundant - I had no problem homing in on the individual samples plastered all over this song. While the TRTs' bass plumbed greater depths than the Hovlands, it didn't go as low as the AudioNotes.

Vocals proved the



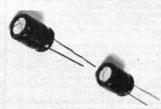
smoothness and power of these caps, with the expression in Tori Amos' singing particularly impressive. Backing violins and harpsichord were less glassy due to a broad tonal range that fell halfway between the paper-in-oils and the Musicaps. Images were properly detailed and proportioned and sat within an attractively transparent sound stage. The TRTs seemed to combine the incisive, forward midrange characteristic of the plastic caps in this test with some of the broad tonal range and low-level detail retrieval of the paper-in-oils. NK - A little less extreme in

NK - A little less extreme in upper mid-band glassiness and projection than the Hovlands, a little better in overall balance due to stronger bass too, although not a match for the paper-inoils. Very good.

JELMAX BLACK GATES (£1.83 each)

The effect these tiny electrolytic capacitors had on the sound quality was far from small. From the first moment that music started coming through the Sextet Ils, it was obvious the Black Gates had cleaned up the overall sound, removing a layer of grunge from the amplifier's presentation.

Tori Amos' piano and vocals were now firmer as well as more dynamic and realistic, their images packed full of a subtle detailing that never became overwhelming.



The band members were solidly positioned in an acoustic made recognisable thanks to the transparency the Black Gates brought to the proceedings. With the extra breadth and width the sound stage now possessed, music took on life-like proportions and was much more involving.

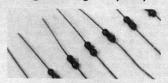
The Black Gates seemed to have a similar affect to the paper-in-oils where bass was concerned. They removed the mush that normally obscures the cues in the lower octaves that build up an acoustic and add space to the sound stage. But they also tidied up the performance of midrange and treble, with greater insight and detail, especially obvious on strings, lending Vivaldi's Four Seasons a realism that made listening addictive.

NK - Phew! The Black Gate lived up to its reputation, one little capacitor immediately improving image body and solidity right across the audio band. This component change

was the best we made in my view.

AUDIONOTE TANTALUM RESISTORS (£1.99 each)

NK - These were added into the circuit in the positions shown in the circuit diagram. Their effect was quite obvious, being not too dissimilar to that of metal film resistors. They brightened and hardened up the sound, adding some high frequency



'hiss' to cymbals that warned there was now a little too much emphasis on high frequency retrieval. Our overall view here was that these resistors need to be used with care and according to conditions. The Tonigen ribbon tweeter of the Heybrook Sextets is one of the most revealing going; others may make more or less of the effect. Also, what comes over as extreme glassiness and hardness with CD sounds far more acceptable with LP, posing the question: are these components simply revealing more of CD's problems?

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The Riverside 4040 is our integrated amplifier. It features dual mono construction and has five line level inputs and both 4Ω and 8Ω outputs. The output stage is configured in the classic McIntosh connection, which gives stable, wide-band operation even with difficult loudspeaker loads. The stainless steel chassis and treatfering the riversity of the stainless steel chassis and treatfering the riversity of the stainless steel chassis. izuuspearer roads. The stainless steel chassis and transformer cover are hand polished to a mirror finish, and come with a semi-matt black valve cover. 4xEL34, 4xECC83, 2xECC82. A full description, including circuit diagram, is given in the 4040 reference manual, £6.50. Kit £780, fully assembled £995.

assembled \$995.
Technical specification: dual mono construction, 40W/channel, 12Hz to 25kHz power bandwidth, distortion <0.1%, five line level inputs, tape output, 230/240V mains input. Stereo amplifier circuit board: board only \$49.50; component pack (including valve bases), add £63; populated board £125; full valve set, add £45. Power supply board: board only £20.50; component pack, add £44; populated board £66. Input board: board only £15.50; component pack, add £16; populated board £66. The populated board £66. The populated board £66. The populated board £67. The output transformers are configured for

board \$33.

The output transformers are configured for the McIntosh connection and have excellent low frequency response and a primary reflected impedance of 3800 \(\Omega\$. Full connection instructions provided. Price \(\Sigma\$. The mains transformer is wound for dual mono construction, as this gives superior isolation between channels which sharpens imaging and eliminates inter-channel ground loops in the amplifier. Primary 0-230-240 \(\Sigma\$. Secondaries \(\Sigma\$. Yes \(\Sigma\$. At \(\sigma\$, \(\Sigma\$. The primary voltages \(\Sigma\$. Other primary voltages \(\Sigma\$. Price \(\Sigma\$. Other primary voltages \(\Sigma\$. Price \(\Sigma\$. Other primary voltages \(\Sigma\$. Supplied to special order. \(\Data \) Bata sheets giving connection diagrams, specifications, as well as circuits for using each transformer, \(\Sigma\$. So each. \(\Sigma\$.

Weil as circuits for using each that should be each.

The chassis, comprising main chassis and transformer cover, is hand polished, welded 1/16" stailless steel - NC machine tooled for a perfect fit and clean finish. Each kit also includes a mesh valve cover and baseplate, finished in

semi matt black. Price £310. Also available in mild steel finished in black, £195. For those who wish to use one of these high quality chassis for their own projects, details of the chassis are given in the 4040 reference manual, £6.50.

Connector kit: twelve gold plated phono connectors, two sets of loudspeaker terminals, an IEC mains socket with integral fuse and switch, and an IEC mains lead with fitted 13A plug, £51.50. Cable kit: all cables required for the 4040, £6.

4040, £6.

The Riverside P2 phono preamplifier is designed to partner the Riverside 4040 for those who enjoy the vinyl sound. Equalization is provided for moving magnet output to line level. The P2 features a high accuracy feedback RIAA equalization circuit, ensuring a natural tonality, a regulated high voltage supply per channel and cathode follower outputs. 3xECR8, 1xECC81, 2xECF80. Full details and circuit diagram in the P2 reference manual, £6.50. Kit £225, fully assembled £275. embled £275.

assembled \$275. Technical specification: $47\mathrm{k}\Omega$ input impedance, $1\mathrm{k}\Omega$ impedance output for driving long interconnects. Stereo circuit board: board only \$25; component pack, add £37.50; populated board £70; full

valve set £20.

valve set £20.

The mains transformer is wound for dual mono construction and is toroidal for low leakage flux. Primary 0-230-240V. Secondaries 2x295V@20mA, 2x6.3V@0.45A, 16V@1A. Price £30. Other primary voltages can be supplied to special order. These transformers are also suitable for power supplies in preamplifiers and other line level valve circuits see data sheet for details, £2.50.

The chassis (main chassis and transformer cover) is made from mild steel. Each kit comes complete with a mesh valve cover and

complete with a mesh valve cover and baseplate, finished in black. Price £110. For

basepiate, inisined in black. Price £110. For those who wish to use a high quality chassis for their own projects, details of the chassis are given in the P2 manual, £6.50.

Connector kit: four gold plated phono connectors, IEC mains socket with integral fuse and switch, and IEC mains lead with fitted 13 A place £15.

and switch, and IEC mains lead with fitted 13 A plug, £15.
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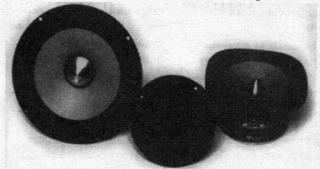
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ACOUSTICS and PSYCHOACOUSTICS

by David Howard and James Angus.

Reviewed by Noel Keywood.

ooks on acoustics are becoming more common, but each has its own particular approach to the subject. Traditionally, the area has been split between two camps: musicians and architects. Seashore's Psychology of Music (McGraw Hill) is an early example of the first and Beranek's Acoustics, available from our World Library (p58), an example of the second.

Both are what I would loosely term 'mechanistic'. There is another emergent camp that approaches the subject from the other direction, looking at audible perceptive strategies from the biological viewpoint. It seeks to understand our hearing function in evolutionary (Webster, Popper and Fay) and psychological developmental terms. This approach concentrates on our interpretations of what we hear, is a branch of medical science and is producing, in parallel to the mechanists, a large body of fascinating information. As Yost says, "in the past a distinction has been made between sensation and perception", perception being treated in vague terms.

The traditional mechanistic approach to psychoacoustics is under fire from others in the field, who feel its explanations either don't go far enough or are just plain useless. "A number of investigators have argued that audiogram thresholds and other psychoacoustic measures correlate poorly or not at all with those measures attempting to tap a listener's ability to function acoustically in daily life".

I mention all this to get Acoustics and Psychoacoustics into perspective. It comes firmly from the mechanist camp. And it does a good job. But when I see the word "psychoacoustics" I do rather wonder whether I've got to plough through dense paragraphs and complex diagrams of hairy cochleas, of more use to a surgeon than someone, like myself or a potential purchaser of this book, who needs to make sense of our senses.

In this case, the cochleas have it, together with the conchas, incus and all manner of auditory bits and pieces, from page 66 onward. However, that is not to deny that the book covers valuable ground. It is written by and aimed at those interested in music recording and performance.

Early chapters cover the usual ground, considering air speed, wave compression, reflection, refraction, resonance and various other physical phenomena. There is a useful number of equations, but the authors have tried to make the book easy to comprehend. The explanations are nonetheless comprehensive and detailed.

After talking about the physics of sound and the biology of the human auditory system, the book moves in apparently logical progression to Notes and Harmony. Here we are getting firmly into music theory and some of it I found fascinating. I had always thought that the good Dr Ohm was an expert on

ACOUSTICS AND PSYCHOACOUSTICS

MID M. HOWARD
JAMES ANGUS

SCHOOL BALLS BRISTS

SCHOOL BALLS BRISTS

current through resistors, but it seems he also developed an acoustical law. Coverage of psychoacoustics from this point of view, namely how we perceive groups of tones and such like, is thorough and well supported with references, both within the chapter and at its end.

The arrival of Chapter 4 clearly signals which way this book is heading. Entitled Acoustic Model for Musical Instruments it explains how musical instruments work, including human vocalists. The subjects of Timbre and

Masking follow, with the inevitable reference to 'deception' that engineers make when discussing masking effects. I'm sure Yost would see 'deception' more as a sophisticated biological form of 'optimisation'.

The penultimate chapter considers rooms, studios and acoustics. It covers basic theory more than practical acoustics solutions, although I was amused to see the use of side wall absorbers to produce a reflection-free listening zone in a room, since we regularly recommend this. However, the influence of the rear wall, and of diffraction as an alternative to adsorption, are not discussed. The book quite often resorts to theoretical generalising where, I suspect, the authors have little practical knowledge. And finally, in the last chapter, electronic sound processing, including equalisation, phasing, reverberation, compression and other studio effects are covered very quickly.

Leaving me to categorise this book as a good choice for music students and ear surgeons. Its approach is more theoretical than practical, but for anyone studying acoustics for the first time the explanations are about as easy as they come and the coverage wide too. But everyone in audio ought to be aware that human auditory perceptive strategies are not as simple and mechanistic as traditionally presented in books like this. Making the scope of the 'psychoacoustic' contribution a bit limited and limiting. I would like to have seen a bit more breadth of discussion in this important and profound area

Acoustics and Psychoacoustics

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22

AUDIO POWER AMPLIFIER DESIGN HANDBOOK

by Douglas Self.

Reviewed by Andy Grove.

he Audio Power Amplifier
Handbook follows from a series
of articles by Douglas Self
published in Electronics and Wireless
World, but of course the book allows
the author to cover the subjects in
greater depth. Mr Self is a respected
audio engineer and currently designs
professional equipment such as consoles
for the Soundcraft Electronics company.

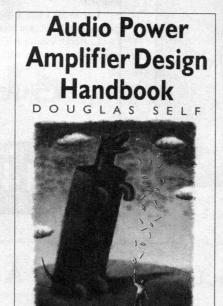
Douglas has analysed the distortion mechanisms of the various stages of the amplifier and presents methods for their reduction or elimination. In the opening chapter Doug attacks the subjectivist movement with a vengeance. It's all done very logically and the arguments presented seem valid. Here also the general requirements of power amp performance are laid out, with safety and reliability first and foremost, progressing through well known lab test parameters such as damping factor and distortion.

The second chapter gives the reader a quick overview of two possible amplifier topologies. The different classes of operation such as A, B, and H are described quite briefly, but the book really concentrates on Class B output stages. A 'for' and 'against' list of features for AC and DC coupled amplifiers is also presented. From there Self goes on to justify the use of negative feedback, his argument mainly hinging on how it reduces distortion. But he also points out that the distortions produced at each stage can be minimised before feedback is applied, maximising its effect.

In Chapter 3, Self's eight distortion mechanisms are introduced. These are distortions which he seeks to reduce to make an amplifier more linear, before feedback is applied. Here also the 'generic amplifier' is introduced. This is the almost universally used three-stage circuit with input differential pair, voltage amplifier and output buffers.

The next three chapters offer a stepby-step analysis of the generic circuit, starting at the input differential pair and proceeding through the voltage amplifier to the output stage. The analyses are in depth and Spice models are used to predict behaviour, together with some real-world prototype circuit tests. All kinds of goodies are described, such as current mirror loading of the input pair, constant current sourced VAS stages and the innumerable different output stage types from the simple emitter follower to complex triplets.

Chapter 7 covers the issues of



stability, compensation and slew rate in great detail and Self illustrates the various effects of the amp's set-up, such as input stage operating current on its high frequency and slewing performance.

The following chapter investigates the power supply and its effect on performance. Even the wiring and earthing of the circuit is taken into account. This is valuable for less experienced engineers. Self concludes that the best approach is to maximise the amp's power supply rejection ratio rather than making the supply super stiff and quiet.

Chapter 9 is all about Class A amplifiers. They are introduced as a way to decrease distortion from the output and driver/voltage amplifier stages. In this chapter there is a very novel output stage quiescent current monitor and controller and the 'Trimodal' amplifier which can be a Class A, B or AB.

In Chapter 10 the FET output stage is explored, but Douglas is not a fan of the

FET, mainly due to its lower transconductance manifesting as higher distortion when used as a follower, so this chapter is quite brief.

Chapter 11, entitled 'Thermal Dynamics of Class B Output Stages' addresses just that, and Self uses Spice modelling techniques to predict thermal performance by converting various thermal elements to electrical ones. The thermal issue is a very important one, not only for the purpose of reducing distortion but for the practical reason of avoiding thermal runaway and output stage self-destruction if you get it wrong!

The final three chapters are practical and down to earth. Covering protection circuitry, mechanical design including PCB layout and final testing.

For those who want to build a reference quality solid-state amplifier this original book is essential. But it should form part of a library and not be taken as the bible of power amps because it is very specific in its coverage. There are numerous other topologies, apart from the 'generic amplifier' topology, which may or may not offer advantages.

Douglas Self has made it a personal quest to perfect this particular amp topology, something I thought Hitachi did back in the Seventies with their super high feedback MOSFET amps. Self's criterion of amp goodness is to have the maximum amount of zeroes before the one in the distortion figures. It's like trying to characterise a car from the engine's power output or wheel diameter; it's all just specs in the end.

This is an original and informative book written in a very easy to understand style, which indicates that the author knows what he is talking about. But I wish Douglas would discard his Paisley shirt and psychedelic kipper tie, put a little more faith in his senses, and a little less in his test gear.

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D.I.Y. Letters

Andy Grove (ex-Hi-Fi World, now Audio Note) says -

You could do quite a lot to increase the sonic performance of your head amp. You could upgrade the electrolytic capacitor to Black Gate types and possibly fit tantalum film resistors, but you seem to be concentrating on the power supply and it's quite often a good place to start.

Ideally you would use a choke input filter and low noise shunt regulator. We've got some high current chokes for filament supplies at Audio Note. Using a large capacity mains transformer and reservoir caps could work quite well. Linear Technology make high performance regulator ICs. Check the audio parts guys' catalogues.

One tip is not to put a super large capacitor on the output of the regulator chip; the data sheet will advise.

Also, it may be worthwhile putting a small resistor

between the output of the chip and the cap, 10 ohms

Another way of making a super cool regulator might be to use a high performance power op-amp IC and a voltage reference IC for each rail. Make sure the power op-amp has a good frequency response, and again be wary of using large capacitors on the reg's output.

A word of warning, shorting the regulators output may result in instantaneous destruction of the op-amp unless it is internally protected. Of course this is only likely to happen if you are careless with the meter probes. There are various circuits around in the reference books from Maplin and so on, for discrete and IC regulator circuits, check them out. AG

Noel says

There are many forms of power supply, each with its own strengths and weaknesses, as well as

POWERING UP

I am looking to squeeze a bit more performance out of your phono head amp, and am considering building a beefier power supply. My inspiration is the Michell ISO, which sounds much better with its Hera power supply.

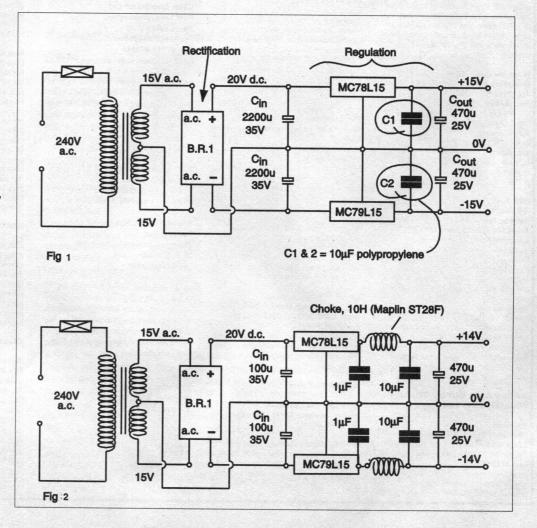
Would this be a worthwhile proposition? If so, how far should I go? If I follow the Russ Andrews school I would end up with a 200VA or so transformer and 20,000µf reservoir caps on each rail. While I would be prepared to build something along these lines, I assume that something smaller would fit the bill. Can you suggest something?

Also, if I do uprate the power supply should I also replace the voltage regulators with something rated a bit higher, say I amp or so?

Steve Hall

East Carleton,

Norfolk.



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adherents of course. Here are some options, that relate to power supplies in general, you might like to consider.

Note what Andy says here. Furthermore, looking backward from amplifier into

power supply, the amplifier

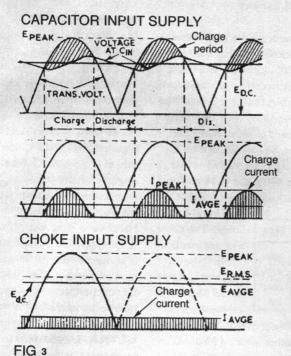
determined by its dynamic behaviour, noise etc will influence the load. So, in effect, you end up listening, in part, to the voltage regulator. That is why Andy recommends using a high performance audio power amp as a regulator; it is also why valve regulators are best.

Generally speaking, solidstate voltage regulators work best at low frequencies and invariably give tight sounding bass, but they are less pleasant across midband and treble. If you increase input capacitor Cin you pulse the transformer and mains supply more heavily, as transformer volts rise above Edc to Epeak (top trace in Fig 3) which is not a good idea in principle, although in this case little current is being drawn, unlike a power amplifier.

Increasing the output capacitor, Cout, will have little effect, because of the voltage regulator's low output impedance. All the same, you will find a large value polypropylene across the output 470µF electrolytic, as shown in Fig 1, cleans the treble.

The best way to decouple the power supply from the amplifier, and to draw current more smoothly from the transformer, is to use a choke. It might seem daft to put a choke after a voltage regulator, since the DC resistance (150 Ω in the Maplin choke) destroys the regulation, but in this case the regulators are there only to guarantee the lines can't rise above 15V. A large value choke (3-10H) decouples the amplifier stage from the supply effectively and makes the output capacitor more influential. Use a 470µF/25V Cerafine or Black Gate as an output capacitor, optionally bypassed by an audio grade polypropylene - experiment to see what you prefer.

Providing the input capacitor is kept low, around 100µF or lower if hum is not a problem, then current draw from the transformer is smooth over the whole of a voltage cycle, as shown by lavge in the bottom diagram.



Our phono stage power supply uses a normal capacitor input topology where rectifier BRI charges 2200µF 'input' capacitors. This provides a fairly hum free 20V that feeds the MC78L15 (+ rail) and MC79 L15 (- rail) voltage regulators. These hold the output voltage steady irrespective of input voltage (i.e. mains) fluctuations or output current variations. It's simple and it guarantees DIYers a 15V line free of hum, since both the capacitors and the voltage regulator act to smooth the supply. The AD797 supply voltage is rated at 15V maximum and running the chip at full line volts gives maximum signal output swing of around 10V rms.

This is a safe, cheap and reliable supply, of a sort much used generally. However, chip voltage regulators have a very low output impedance that defies the efforts of output capacitors to swamp their influence. I've experimented with many such regulators and find they are noisy, about which little can be done.

sees a solid-state power output stage. Since the amplifier effectively routes the power supply current through the load, the sound of the power supply, as

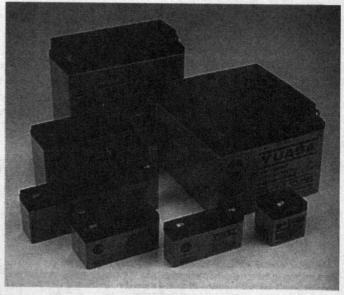
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to 10 psi, will dispel the excess and reseal itself. The 'non-spillable' feature of these batteries means that they can be operated in any position, unlike the usual form of vented lead-acid battery which is strictly 'one-way-up'. A service life of 5 years should be expected if the batteries are used most often in the 'floating' or 'standby' modes of operation, where top-up trickle charging is regular and discharge is infrequent. The batteries also feature a low 'self discharge' rate of only 3% of rated capacity per month, allowing the battery to be left unused for some time without loss of efficiency or any appreciable deterioration of performance



Because these lead-acid batteries are sealed, some care has to be exercised whilst charging, and it is recommended that a stabilised, constant voltage source should be used, with current limiting proportional to the battery's Ah rating. Car battery type chargers must never be used. Battery performance and service life will be directly affected by the choice and efficiency of the charging circuit used. Constant voltage charging is the most suitable method, and the output must be within 2.25 to 2-30 volts per cell for trickle charging, or in the case of 'cyclic' use 2-40 to 2-50 volts per cell.

In effect, the choke, being a reactance, stores energy, releasing it into Cout and the load, during the discharge period. This will improve sound quality. You might be interested to note that Cin should be made as small as possible in this arrangement, and Cout made large. This arrangement approximates to a choke input power supply, considered something ideal, although a pig to implement I have found.

Another option seriously worth considering with a high gain, sensitive preamp in particular, is to go battery. Use two 12V sealed lead acid types, which have a very low output impedance, one for each rail. Recharge them over night. The Yuasa XG74R from Maplin at £18 apiece will suit. NK

QUICKSILVER MESSENGER

In Australia I have just obtained a copy of your October '95 issue and I think I can help Andrew Footman from Wolverhampton, who asks for information on the Quicksilver amplifiers, in particular the 8417 valves.

Note that the ratings for the KT88s are for genuine GEC M.O. Valve Co. By all accounts, the Chinese derived KT88s (currently available through PM Components, Golden

Dragon, Billington Gold et al.) are better run at considerably lower plate voltage to avoid flash-over problems.

Typical operation points for all the valve types listed at a B+ of 450V are almost identical - around 50mA standing current per tube, with a grid I bias of -15V to -20V. In fact, the 8417 needs a slightly lower bias voltage, which means it is very easy to drive.

Based on these ratings, Andrew could directly (well, almost directly - see

RATINGS	8417	6550	KT88	EL34
Anode volts Screen volts	500V 500V	660V 500V	800V 600V	800V 425V
Anode power	35W	42W	42W	26W
Screen power	5W	6W	6W	8W

info on pins below) substitute a KT88 or 6550 and be well within the design centres for any 8417 circuit.

The KT88 and 6550 can be directly substituted for the 8417, with one ESSENTIAL check needed. I have a base diagram for the 8417, which shows their plate internally linked to both pins 3 and 1. Andrew would need to check that the Quicksilver plate leads go only to pin 3. If so, the following pins apply for the three types:

Pin I. no connection

Pin 2. heater

Pin 3. plate

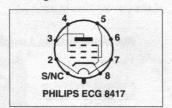
Pin 4. screen Pin 5. grid Pin 6. no connection Pin 7. heater Pin 8. cathode

My info. on the monoblock Quicksilver is that they are 100W ultralinear amplifiers. I don't have any info. on their HT, but I suspect it would be about 450V, with a standing current of about 55ma per valve. See sketch of circuit.

If the B+ measures less than 430V, the EL34 could be substituted, provided that

> pins I and 8 are linked. The other pins are identical. My recommendation would be to find a decent set of

KT88s, join pins 3 and 4 together with a 100 ohm resistor, and run them as triodes (disconnect the screen taps on the output transformers). Andrew would then have 50 watts of class ABI triode power - a real challenge to the Audio



Research Classic 60s. If the EL34s were strapped as triodes, he would get about 35W.

I hope this is useful information for Andrew, if he hasn't already had help from elsewhere.

Andrew Neale Modbury Heights, South Australia.

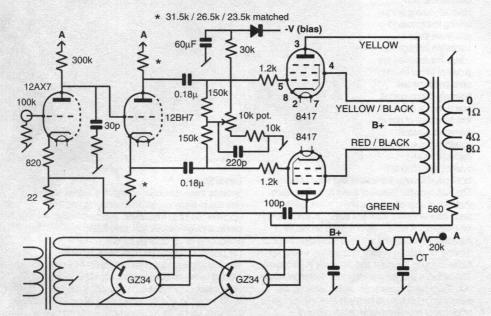
Thanks. We have reproduced your circuit from fax and hope it is correct, since some values were not clear and B+ is commonly on the output side of the choke. Our base diagram for the little mentioned 8417 comes from the Tube Substitution Handbook. Here, the plate (anode) goes to 3 alone and I is either an optional Screen (not an electrode) or No Connection, according to the manufacturer. NK

ULTRA-LINEAR

I was most interested to discover your magazine last year as one which treats valves and vinyl seriously and I found your comments on valve amplifier design in the November supplement most interesting particularly your rejection of ultra-linear operation for your K6L6 and K5881. Following the Mullard and GEC treatises I had been brought up to think of this as the 'be all and end all' of amplifier design.

I do however have a couple of queries. Firstly much has been written on the superiority of triodes over pentodes as output devices but I have never seen any comments on their pros and cons in earlier stages of power amps or as preamps: do similar comments apply? The Mullard power amps all use pentode inputs whilst GEC go for triodes and Quad seem to have taken the GEC design and replaced two triodes with a pentode. For preamps all three use a mixture of triodes and pentodes.

In my own aged equipment all except outputs are triodes. Rogers for example in my Cadet 3 drives the output pentodes from a



QUICKSILVER AMPLIFIER (one channel)

single triode anode/cathode phase splitter with gain provided by a preceding triode voltage amplifier. In the preamp section he uses a further 3 triodes to get from the MM phono input giving 5 triodes in all per channel the first 3 being the now rare ECC807, designed specifically for this application as a superior low noise ECC83. Going further back to my state of the art domestic audio of 1950 (a KB radiogram) the output tetrodes are driven by an amplifying phase splitter using two triodes (GEC's 'floating paraphase phase inverter') preceded by a voltage amplifying triode for the detected radio signal. A fourth triode is brought into use for phono for the weaker signal from the Decca XMS variable reluctance pickups.

Neither piece of equipment uses UL output and seems to manage well enough without: QED I suppose. Indeed I imagine I would have to expend a fair amount of cash to better the musical quality of the Rogers on my preferred (classical) listening. How would your K5881 or K6L6 compare I wonder?

Secondly, I find that in general I get a more immediate, lively and atmospheric sound from LP than CD making music more involving with the former. With the Rogers I use a Goldring-Lenco GL75/Shure M75ED T2 combination and a Technics SL PG 460A CD player. Speakers are Wharfedale Lintons I 'reengined' a year or two back with Audax I" soft dome and 8" paper cone/foam surround units and 4 new element crossovers. I thought I perhaps had a bright cartridge and dull CD player but the Technics got excellent reviews and when I bought it I also auditioned the much lauded Marantz CD63 but thought that sounded rather dull and didn't like it.

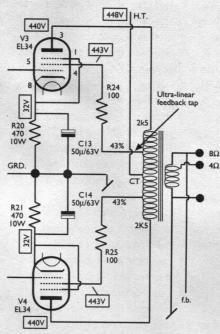
Would upgrading to a

better CD player give me a more LP like sound? I suspect not and that the problem lies in the nature of the medium itself. When I have heard new DDD CDs which I also posses on the radio they have the same rather anodyne sound and yet with the odd disc the Technics shows it can provide a lively sound. Mercury 'Living Presence' CDs seem sharpest (perhaps due to their careful remastering, playing the mastertapes on the original valve recorders on which they were made). In one case where I have the same item on Mercury LP and CD the sound is virtually indistinguishable; in other cases where I have the same recording in both formats LP is always more immediate.

Finally I note that the distinguished audio panel in the magazine 'International Classical Record Collector' in their camparisons of a CD with various different LP cuts from the same master have so far always placed the CD last for audio quality. Enough said?

I would be interested in any comments you may have. Nicholas Coleman Newton-le-Willows, Merseyside.

The output transformers of our K5881 amplifier have a high primary impedance, which helps keep the output stage intrinsically linear. It offers better measured performance, I found, when using the linear 6L6 valve (in rugged 5881 form) than an EL34 working in ultra-linear mode. Feedback skews an amplifier's transfer characteristic and did so when applied from a transformer with ultra-linear taps. Distortion changed in its harmonic structure as level rose. What this means is that



MULLARD 5.20 ULTRA-LINEAR OUTPUT STAGE

the pattern of distortion becomes modulated by level, not a good sign. So in my experience the complexity of ultra-linear is unnecessary; better basic design is the answer.

Andy Grove is happy with it though. He says "I have found that ultra-linear does seem to work, electrically at least. It makes a pentode operate halfway towards a triode and produces more even order distortion. Of course, ultra-linear is not the same as true triode but it offers efficiency in between pentode and triode. There

are problems with ultra-linear in that unless the output transformer is very special the screen tap will not be coupled to the anode at high frequencies and instability results. This made the old designers put caps and resistors all round the transformer to stop oscillation. Also, the commonly used 43% is not correct for every operating condition or valve. The tapping point has to be designed in."

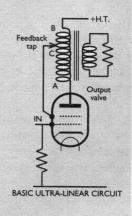
Running the K5881 output stage 'straight', with the 5881 screens just a few volts below the anode produces just a small amount of second harmonic distortion, an innocuous characteristic. However, this is specific to the 5881 valve, which draws little grid current due to the electrode alignments. Generally, the advice is to run the anode of a tetrode at as high a voltage as possible and the screen at half anode volts, from a 'stiff' supply (i.e. one that is regulated). The ideal is postulated as a 50% tap on

ULTRA-LINEAR OPERATION from AMPLIFIERS AND SUPERLATIVES by D.T.N. Williamson and P.J. Walker.
If the tap is affixed to point A, giving a coupling factor of unity, the

stage behaves as a triode, if at B as a simple tetrode. If now the screen is tapped at intervals between

point B and point A there will be a progressive inclusion of the load impedance in the screen circuit and a progressive change from tetrode characteristics at B to triode characteristics at A.

In the case of the single valve there would appear to be little gained from this circuitry. With push-pull the reduction in distortion is greater than the reduction in gain, because of the cancellation of second harmonics. This "something for nothing" is small, however, and can be lost or even reversed if there are any appreciable departures from precise balance at any frequency.



the mains transformer secondary, regulated to keep within the screen voltage rating - often 300V or so. A common approach is to use a potential divider to establish this voltage. Such an approach maximises power output and keeps screen current down.

However, I have to say that with K5881 this approach was tried and did not work, reducing power and increasing distortion, showing that much depends upon individual circumstances and components.

Recently, I reduced feedback in K5881 as far as possible (to 18dB) consistent with an upper bandwidth limit (-1dB) of 20kHz. This has helped open up the sound, improving depth perspectives in particular.

It's probably best to say that CD and LP are just 'different'. By and large, cheap CD players do a better job than cheap record decks, as well as being more convenient of course. The situation changes as price goes up, because CD is performance limited by its old 1970s digital coding system, whilst LP, being analogue, is not. So the more money you throw at it, the better it gets. **NK**

Andy Groves says -

There are four fundamental differences between triodes and pentodes;

- I. For a given transconductance a pentode will generally give higher gain than a triode due to its much greater internal impedance.
- 2. The positive potential on the screen grid allows a pentode to sink more current at low voltages than a similar triode, this equates to higher efficiency in output stages.
- 3. For a given transconductance a pentode

will create more noise than a triode due to the random distribution of currents between the anode and grid screen.

4. Pentodes are easier to drive at high frequencies, in a triode the Miller Effect loads the input capacitively at HF, but the screen grid in the pentode prevents this.

There is possibly a fifth and that is that pentodes tend to produce a more complex harmonic distortion pattern than triodes, but it does depend on how the pentode is being used. In output stages pentodes do usually produce higher order harmonics than triodes. So the pentode is more efficient power wise, has higher gain and is easier to drive at high frequencies thereby making wide bandwidth more easily achievable. The triode however is quieter and generates simple low order harmonic distortion and its low impendance helps with speaker damping. These criteria are important for audio quality amplifiers and for the best amps triodes are usually chosen throughout.

In output stages one would ideally want the high efficiency of the pentode and the low distortion of the triode. There have been several attempts at achieving this performance and Ultra-Linear was one of them. To make a pentode operate as a pure pentode the screen grid is held at a rigidly fixed voltage. If however the screen grid is connected to the anode, the pentode starts to operate like a triode. Engineers thought that if they could connect the screen to a voltage which was somewhere in between they might get some of the advantages of both the triode and pentode. They connected the screen grid to a tap on the output transformer so that a percentage of the anode swing was fed into the screen grid. A 43% tap (a commonly used value) feeds 43% of the anode voltage swing into the screen grid. They found that it was possible to make a mutant hybrid of pentode and triode which gave good efficiency like the pentode but which also gave more even-order distortions which would hopefully be cancelled by the push-pull operation.

Unfortunately, they soon discovered that just bringing out an extra wire part along the main primary winding caused stability problems and so resorted to adding extra components around the output transformer or making very complex windings. It seems that Ultra-Linear fell from grace due to it being a bit of a pain in the butt. **AG**

DIPOLE DYNAMICS

Your article on the equalised dipole subwoofer was extremely interesting, since I have been working on this very topic for almost two years now.

I substituted your equalisation circuit for my own, which incidentally had the same equalisation minus the I40Hz peak. The benefits were immediately noticeable - much improved transients and a feeling of increased speed at low frequencies.

Increasing the peak slightly to 3dB improved things even further, although there was an increasing need to move the dipoles even further away from the rear

walls due to an excitation of room/boundary at 140 Hz.

It may have been due to my hurried construction but I could not achieve stability with the subsonic stage and had greater success with the circuit below, which I modelled on my own PC

I did find that I much preferred (on my dipoles) no

subsonic filter at all. You say that you feel it adds to the subjective speed at LF. I must confess I cannot detect this. However, for those using vinyl it will be necessary to prevent excessive cone movement.

Yes, without the filter there is tremendous presence of low frequency energy which is readily felt, particularly on organ and bass synthesiser.

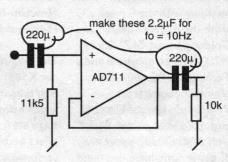
Hope this is of interest to you.

David Huckle Cambridge.

We're always glad to hear of people achieving success with interesting and advanced acoustic techniques beyond the understanding of the general hi-fi business. Proves how strong DIY can be.

I never encountered instability in the crossover, even when tuning in outrageous peaks, but layout and power supply decoupling (especially) do need to be attended to carefully.

Cone excursion is a problem with a dipole trying to produce high level subsonics and for safety, as well as for LP warps, I gravitated toward using a second order high pass filter at 20Hz, forsaking the delights of experiencing structural re-assembly of the



brickwork around the listening room.

Your circuit comprises two passive high pass sections with the op. amp. acting as a non-inverting stage between them. The right capacitor value is 2.2µF for a 10Hz turnover frequency, not 220µF. **NK**



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